BULLETIN OF THE HISTORY OF MEDICINE

ORGAN OF
THE AMERICAN ASSOCIATION OF THE HISTORY OF MEDICINE
AND OF
THE JOHNS HOPKINS INSTITUTE OF THE HISTORY OF MEDICINE

Founded by Henry E. Sigerist

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VOLUME XXIX

BALTIMORE
THE JOHNS HOPKINS PRESS
1955

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Medical

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ORGAN OF
THE AMERICAN ASSOCIATION OF THE HISTORY OF MEDICINE
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THE JOHNS HOPKINS INSTITUTE OF THE HISTORY OF MEDICINE

VOLUME XXIX JANUARY–FEBRUARY, 1955 NUMBER 1

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Manuscripts, review copies of books, and correspondence relating to the publication of papers should be addressed to The Editor, Bulletin of the History of Medicine, 1900 E. Monument St., Baltimore 5, Md.

Contributors of articles will receive 25 reprints without covers free of cost. An order form for additional reprints, giving the cost, is sent with the galley proof.

The Bulletin is published bimonthly. One volume of at least 500 pages is published during the year. The subscription rate is $6.00 a year in the United States and countries of the Pan-American Union, $6.25 in Canada, and $6.50 in other foreign countries. Single numbers when available are $1.50 each. Prices for back volumes may be had on application. Volume I is out of print. New subscriptions are entered to begin with the first issue of the current volume.

Active and Non-resident Members of the American Association of the History of Medicine receive the Bulletin on payment of $6.00 annual dues, of which $5.00 is for a year's subscription. Constituent Societies pay $10.00 annual dues, of which $6.00 is for a year's subscription to the Bulletin.

Claims for replacement of missing numbers must be received within 3 months (6 months in the case of foreign subscribers) following publication of the number.

THE JOHNS HOPKINS PRESS

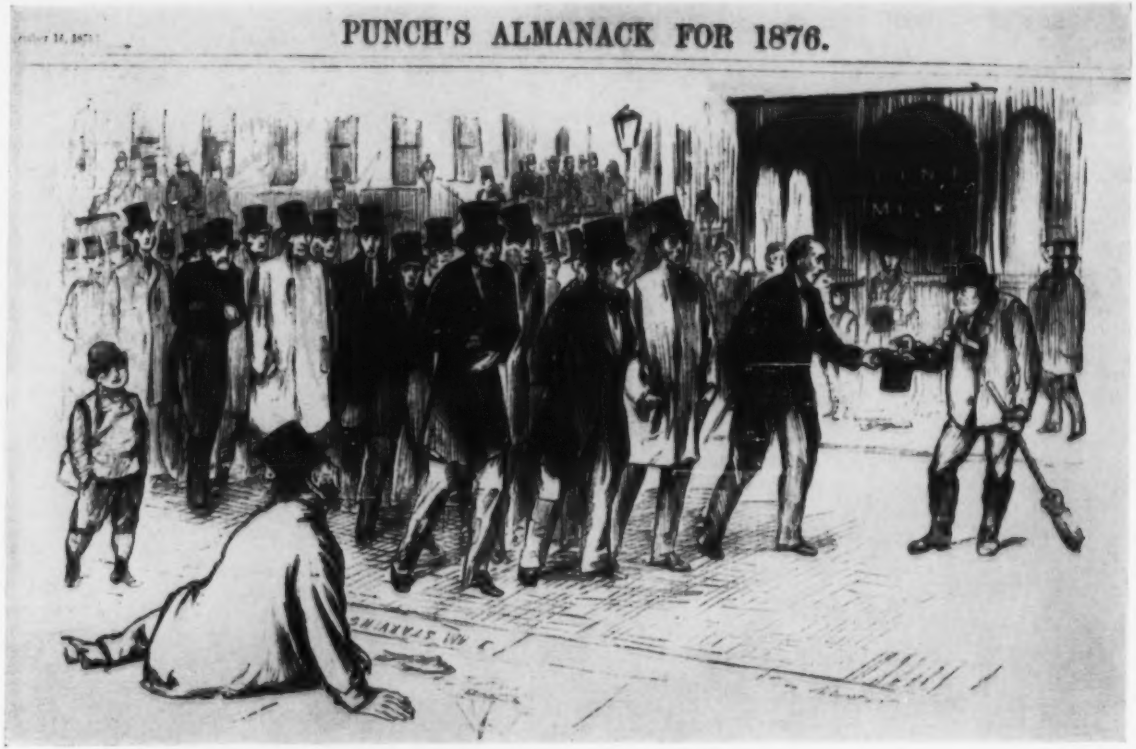
BALTIMORE 18, MARYLAND, U. S. A.

PUBLISHED BIMONTHLY

January-February, March-April, May-June, July-August, September-October, November-December

Made in United States of America

Entered as second-class matter January 3, 1935, at the post office at Baltimore, Maryland, under the Act of March 3, 1879.



DOCTORS (IN HYGEIA) DIFFER (FROM THOSE IN LONDON).

Scene in Dr. Richardson's City of Health.—Chorus of Medical Practitioners.
"We Have no Work to Do!"

—From *Punch* of Dec. 16, 1875. Reproduced by permission of the Proprietors of *Punch*.

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SCIENCE DOWN THE DRAIN

On the Hostility of Certain Sanitarians to Animal Experimentation, Bacteriology and Immunology *

LLOYD G. STEVENSON

There can be no doubt that medical and scientific elements were present from the first in the development of the sanitary movement in Great Britain, Edwin Chadwick's supposed contempt for the medical profession notwithstanding. As F. N. L. Poynter has recently reminded us, in a review of S. E. Finer's biography of Chadwick, Dr. Southwood Smith has some claim to be described as "the intellectual father of the public health movement." [1] Southwood Smith was, however, an associate of Bentham, and among the non-medical factors effective in the genesis of the movement, economic and social policy doubtless deserves the greatest share of attention.[2] Whether or not religion and humanitarianism should be given places of importance in the story is not altogether clear. Chadwick,

* From the Department of Medical History and Literature, University of Western Ontario, London, Canada. My thanks are due to my colleagues, Dr. R. G. E. Murray and Dr. C. F. Robinow, for reading the manuscript. A part of this material was presented in a paper on "The Early Anti-Vivisection Movement in Great Britain," read at the twenty-sixth annual meeting of the American Association of the History of Medicine, Columbus, Ohio, 12 April, 1953.

[1] *Bull. Hist. Med.* 27 (1953), p. 585. The phrase is Graham Wallas's.

[2] George Rosen, Economic and Social Policy in the Development of Public Health: An Essay in Interpretation. *J. Hist. Med. and Allied Sciences*, 8 (1953), pp. 406-430.

we are told, was "entirely unsusceptible to gusts of humanitarianism" and was by nature and nurture a hard-faced radical bureaucrat.[3] But Chadwick probably should not be considered, despite his tremendous, his indisputable importance, as the complete representative of English sanitary science *in propria persona*.

It is not the purpose of the present essay to probe the roots of the public health movement in Great Britain. I intend, rather, to consider its later development, when the flower was perhaps a little overblown. And in this later period some of the leading English sanitarians unmistakably reveal the religious motives which guided and guarded their work.

It is well known that many of the chief disciples of sanitary science were more or less strongly opposed to the new sciences of bacteriology and immunology. The evidence suggests that their adherence to an older mode of thought was not cemented by habit and conservatism alone, nor by inability to grasp the new ideas. Perhaps it is less widely known that some among them were also anti-vivisectionists. Indeed active religiosity, anti-vivisectionist sentiment, and disbelief in the value of immunization—usually linked with serious doubts of the "germ theory"—are to be found in such intimate relationship with the sanitarian's faith as almost to form parts of it. To change the figure of speech, one might say that these various symptoms make up a "sanitarian syndrome," of which three well-developed cases are to be presented and studied. Two of the three were in their twenties when bacteriology arose; they were teachable men who had much to learn; yet it was already too late to alter their basic convictions.

The British anti-vivisection movement and the British public health movement grew up together. This may well have been little more than coincidence. The existence of religious elements in the anti-vivisection movement has been obvious enough from first to last.[4] The sanitary movement as it grew up in Britain displayed such elements more and more. The year 1875—when the Public Health Act was passed and a Royal Commission on Vivisection was appointed—marked a climax in both. It may also be taken as the approximate date for the beginning of modern bacteriology, which actually had its start not long before.

Whether the anti-vivisectionist quite denied the utility of animal experimentation, or declared it inadmissible in spite of its uses, he faced a stiff question—where to find some alternative method of attacking the problems

[3] S. E. Finer, *The Life and Times of Sir Edwin Chadwick*, London, 1952, p. 195.

[4] The nature and operation of these religious factors I hope to make the subject of a separate paper.

of disease. The extreme fundamentalist answer cut clear of science altogether. If not a trial of faith or a means of grace to be welcomed, pain was a punishment to be endured; prophylaxis consisted in the avoidance of guilt; the remedies were prayer and repentance. If the sin was the sin of the race, and not that of the individual or the group, this made little difference: disease was still and always the effect of judgment. The answer, then, was to assert that in scientific terms no answer whatever was possible.

There were, however, a number of plausible solutions. Educated Englishmen who disliked animal experiments but had no wish to obstruct the advance of medicine welcomed any apparent resolution of their dilemma with relief and gratitude. A guiltless alternative to what looked like unavoidable wickedness was the great desideratum.

George Wilson (1818-1859), author of a biography of the experimental physiologist, John Reid (1809-1849), designated his work an "instructive tragedy." Had not Reid experimented on the glosso-pharyngeal nerves in animals? And had he not died, in excruciating pain, of carcinoma of the tongue? Wilson regretted that his protagonist (one can hardly call him the hero) had shown no inclination whatever toward the "transcendental anatomy" of Oken and Geoffroi St. Hilaire, observing that "in the hands of Professor Owen and his disciples [it] is daily unfolding truths not more new than beautiful." [5]

But "transcendental anatomy" would serve no longer. It had been knocked on the head—a head of vertebral origin—by T. H. Huxley. The chief of the British transcendentalists, Richard Owen himself, would not hear of anatomy, transcendental or otherwise, as a substitute for animal experimentation. The greatest British anatomist of the age, he was also one of the most energetic opponents of the anti-vivisectionists.[6] Like Huxley, he was temperamentally incapable of doing animal experiments personally; but he threw the weight of his authority against that of Sir Charles Bell, who was constantly quoted as an anti-vivisectionist.

Whatever other proposals might be made—further examples will be cited presently—the answer of answers was discovered in sanitary science. To those of strong religious conviction—those, therefore, who posed the question—this answer had a particularly strong appeal. Sin and disease were old associates. In dirt they were not divided.[7]

[5] George Wilson, *Life of Dr. John Reid*, 2nd ed., Edinburgh, 1852, p. 231; cf. also pp. 179, 190-91, 196.

[6] Cf., e. g., Richard Owen, *Experimental Physiology: Its Benefits to Mankind*. London, 1882.

[7] R. M. Frye, Swift's Yahoo and the Christian Symbols for Sin, *J. of the History of*

The sanitary movement had reached its first peak of enthusiasm in the 'forties. The simple equation of dirt and sickness—dirt including filth of every kind, especially decaying animal and vegetable matter which gave off bad odors and "poisonous" effluvia—struck the popular imagination; and although to sanitarians the advance appeared slow, this impetus was never lost. Throughout the mid-century, for example, Dickens was calling aloud for good houses, good water, good drains, light and air. The great Public Health Act of 1875 was not the only sign that a new peak had been reached in the eighth decade of the century. "Disraeli invented the slogan *Sanitas sanitatum, omnia sanitas,* and his Secretary, Assheton Cross, made a notable attempt to translate it into practice, particularly by his Artisans' Dwellings Act of 1875, which gave the opportunity for Joseph Chamberlain, as Mayor of Birmingham, to show what could be done by enlightened administration to transform Cobbett's 'wens' into well-ordered and healthy cities." . . .[8]

The old sanitarian faith, already amply justified, was given a further chance to operate through a whole series of legislative enactments. The question was not what it could do, but what it could not do, and some believed its power to be almost unlimited. "Sir Edwin Chadwick was accustomed to say that good drainage would cure toothache. Those who did not understand him laughed at the saying. . . . Yet he may have been quite right."[9] This was the opinion of Sir Benjamin Ward Richardson

Ideas, 15 (1954), pp. 201-217, provides a good discussion of filth and deformity as emblematic of sin; see especially pp. 210-216. Not only in the Old and New Testaments but in many English sermons and through a wide range of English literature, examples are cited of the use of filth, excrement, putrefaction and noisome smells as symbols of evil. Levitical pollutions have their counterparts in Greek and other civilizations, although such concepts were already at least partially "secularized" by naturalistic Greek physicians in antiquity. Cf. Owsei Temkin, An Historical Analysis of the Concept of Infection, in *Studies in Intellectual History*, Baltimore, 1953, pp. 123-147. A changing attitude toward cleanliness, with aesthetic considerations and religious ideas of purity both giving way to a physiological approach, which put health in the foreground and intensified the fight against "filth," is here regarded as one of the conditions of "the second secularization of the concept of infection" in the nineteenth century. The laws of the Bible anent cleanliness were then rationalized and considered hygienic. How this new idea could exist side by side with unmistakable traces of the older, religious concept is shown below. In some minds the religious view was supplemented and reinforced, rather than replaced, by secular elements. Possibly unwillingness to break down the conception of filth, to acknowledge dirt to be the mere vehicle of pathogenic organisms, was unconscious resistance to the recognition and analysis of a metaphor which gave satisfaction in the moral realm.

[8] Esmé Wingfield-Stratford, *The Victorian Sunset*, New York, 1932, pp. 121-122. The Food and Drug Act was also essentially a sanitarian measure.

[9] Sir Benjamin Ward Richardson, *Biological Experimentation: Its Function and Limits*, London, 1896, p. 101.

(1828-1896), and during the second half of the century the Chadwick gospel had no more eloquent and active champion.

Richardson's famous address, "Hygeia: A City of Health," was delivered in his capacity as President of the Health Section of the Social Science Association, meeting in Brighton in 1875. A glowing picture of ideal urban organization, guaranteed to eliminate almost all disease, it evoked much enthusiasm.

> No one [wrote Richardson later] was more surprised than myself at the success of this effort. The Dome over my head seemed to echo the address. Lord Aberdare [President of the Social Science Association] was in an ecstasy; the late Sir George Campbell declared he had never been more charmed, and all who spoke to me followed suit. Chadwick was quite demonstrative; Sir Cordy Burrows gave me a luncheon, and one old gentleman declared that as he knew where the city was he would at once go to it. All this was as pleasing as it was new, but it was eclipsed by the newspapers comments that followed. The *Times* had it as its leading article; the other papers gave favourable notices; the Belgian *Moniteur* republished it entire, and I was apprised that Royal personages had read it. I received notes and questions from residents of many centres of the habitable world; tradesmen labelled the goods they had for sale as Hygeian; rich old people pitched on Hygeian residences in which to prolong their days, to the disgust of their younger successors; Mr. Punch was good enough, through Mr. du Maurier, to give it in his Almanac a favourable recognition, and the secretary of a literary and learned institution to which I was about to lecture introduced me to the enthusiastic audience simply as 'the author of Hygeia.' [10]

Perhaps du Maurier's *Punch* cartoon had facets which did not quite catch the eye of the perceptive Hygeianist.

"Hygeia" contains this sentence: "From the study of the past we are warranted . . . in assuming that civilisation, unaided by special scientific knowledge, reduces disease and lessens mortality." [11] This idea was by no means new: it is in the light of its author's further opinions that it takes on a peculiar significance. As for its earlier history, this has been elucidated by Ackerknecht in his study of French hygiene in the first half of the nineteenth century, the question of the effects of civilization on health having puzzled hygienists in the 1820's. The older generation, strongly influenced by Rousseau, thought it perfectly obvious that civilization breeds disease. The central figure of the new group, Villermé, as "the Dante of the hell of the French cotton mills," was not unaware of the ill effects of industrial civilization. On the other hand, his statistical

[10] Sir Benjamin Ward Richardson, *Vita Medica: Chapters of Medical Life and Work*, London, 1897, pp. 238-39.

[11] B. W. Richardson, *Hygeia: A City of Health*, London, 1876, p. 14. The booklet is dedicated to Chadwick.

research on increasing life expectancy tended to reverse opinion. Bérard, one of those who followed Villermé, declared in 1826: "La civilisation fait gagner à la santé publique beaucoup plus qu'elle ne lui fait perdre sous certains rapports." Ackerknecht observes that

> to decide the problem in this direction was—quite apart from the objective data on which the decision was based—a fundamental, internal necessity for those who started an epoch of sanitary *reforms* in a growing industrial society which obviously could never go back to nature again. Continuation of the Rousseau attitude would have deprived their work of its sense. This was a generation that strongly believed in 'Progress' . . . To credit civilization with the increase of disease was inconsistent with such a 'Weltanschauung.'[12]

In this connection it is worth noting that Robert Willis, who had Richardson as his assistant in practice for several years, was the translator of a little book by Professor Marx of Göttingen on how increasing civilization effects the gradual suppression of disease—a book which was published more than thirty years before "Hygeia" but was already a late specimen of its kind.[13]

Now the second half of the nineteenth century, despite its disillusionments, did not witness a falling off of belief in "Progress," partly (indeed secondarily) because evolution could be so regarded. The parallel with the French hygienists of the earlier period extends to the qualifications necessary in the praise of civilization as a health agency. Richardson's *Diseases of Modern Life,* published in 1875 and dedicated to William Farr, deals with the evil consequences of *imperfect* civilization. On the whole, the emphasis lies in Villermé's direction. The idea was capable, however, of negative and subversive, as well as positive, meaning.

The older view, that civilization breeds disease,[14] was not unrepresented in England in the period under review, and the context in which

[12] Erwin H. Ackerknecht, Hygiene in France, 1815-1848. *Bull. Hist. Med., 22* (1948), pp. 140-41.

[13] K. F. H. Marx and R. Willis, *On the Decrease of Disease Effected by the Progress of Civilization,* London, 1844. This book, which I have not seen, is so listed in the Surgeon-General's Catalogue, and MacNalty says that Willis was joint author with Marx. Cf. Sir Arthur Salusbury MacNalty, *Sir Benjamin Ward Richardson,* London, 1950, p. 10. Cf. also Richardson, *Vita Medica,* p. 135. Since Marx *solus* published at Göttingen in the same year a work called *Über die Abnahme der Krankheiten durch Zunahme der Zivilisation,* it is clear that Willis, whatever he added to the original, was in reality simply its translator. For a lengthy abstract, with many quotations, see *Dublin J. Med. Sc., XXVI* (1845), pp. 69-87.

[14] This was not, however, the universal doctrine of the Enlightenment. Something related to the Villermé-Marx-Richardson position also existed. Cf. George Rosen, Political Order and Human Health in Jeffersonian Thought. *Bull. Hist. Med.* 26 (1952), pp. 32-44.

it is found is important. George M. Humphry, Professor of Anatomy at Cambridge, told the Royal Commission on Vivisection in 1875: "Civilization is the great engenderer of disease, and unless the healing art is made to advance in proportion, there will be as the result of civilization a distinct degeneration of man, physical and moral." [15] Civilization, in fact, is likely to destroy health, *unless the healing art is made to advance*: thus Humphry. Civilization reduces disease and lessens mortality, *unaided by special scientific knowledge*: thus Richardson. The difference is in part one of emphasis, but between the two viewpoints there is a fundamental antagonism.

Richardson is said to have introduced no fewer than fourteen new anesthetics. He was also the inventor of the lethal chamber for the painless killing of dogs and cats. A large part of his life was devoted to an effort to abolish pain. "Few men," declared the *Lancet*, "have done more to alleviate the sufferings of the animal kingdom than Benjamin Ward Richardson both in the nature of inventing means of painlessly disposing of the injured and superfluous and in the reform of the routine of the slaughter house." [16] He said of his own research that that part of it done on dead or inanimate matter had been "pleasant to the mind," whatever its outcome. Not so his animal experiments, although conducted as nearly as possible without pain. "They have never been free of anxiety, nor of a sense that, whatever came from them, there was something that was not right." [17] In 1896 he published a book called *Biological Experimentation*, which although it contained a chapter on "Indispensable Experiment," was largely an exploration of all possible ways of avoiding animal experiments and reducing them to a minimum.

> It is a moot-point whether we ought to attempt to interfere with or lessen the pain of Nature by any method of research; or whether it is not our duty to accept pain as an act of Nature warning us of our errors, and telling us to remove those errors, rather than try to master pain by entering into experimental conflict with Nature on her own ground. Whether by any art of ours, beyond improvement in our knowledge of the ways of prevention, we embitter or embetter the manifestation of life, that is the question. . . . [18]

---

[15] *Report of the Royal Commission on the Practice of Subjecting Live Animals to Experiments for Scientific Purposes*, London, 1876, Sect. 635. Humphry's feeling was ambivalent: he was doubtful and troubled about animal experimentation, yet at the same time he saw the necessity of leaving ample scope for science. In this passage the latter element predominates.

[16] *Lancet*, 1896, *2*, 1575; quoted by MacNalty, *op. cit.*, p. 58.

[17] Richardson, *Biological Experimentation*, p. 133.

[18] *Ibid.*, p. 5.

I am in full sympathy with the belief that the prevention of pain is one of the highest aims of medical science. But I thought it well, as an experimentalist, to explain that the aims and objects of experimentation on vital functions are mainly promoted as a speedy and effective method for removing disease and pain from a world that is always making disease and pain for itself; it is always wanting the animal engineers called Doctors [as distinguished from the civil and sanitary engineers beloved of Chadwickians] to cure both; and is forcing some to experiment against time in order to learn how to overcome what never ought to exist in civilized communities.[19]

Richardson had a poor opinion of the great experimentalists; he complained that "they stamp physiology with their own seal, they overshadow philosophical physiology altogether, and they ignore the man who, reasoning from simple open principles, lets nature alone remain as his experimentalist, and draws conclusions from her works of beneficence or of torture."[20] In this he referred not alone to the clinic and the morgue. Study of brain function by ablation and by "perversion of action" had attracted many: "they have discovered some things, but their leading discovery, I fear, is contradiction." He found a "less objectionable mode open" in comparative anatomy combined with natural history. "We have at our command hundreds of differently constructed brains, and an equal number of animals, to which each one of the differently formed brains ministers differently." (This approach, by the way, may be seen in the work of Kappers and of Bolk.) Here he thought he saw "opportunity for discoveries unbounded, and all on a line that will throw a charm instead of a chill over the world at large."[21] Natural history generally he felt to be full of promise. "The Zoological Gardens of Regent's Park beat all the physiological laboratories of the world put together."[22]

In addition to these expedients, and along with the increased use of statistics (William Farr), he recommended other research methods, including history (Creighton), geography (Alfred Haviland), meteorology (Weir Mitchell), physical chemistry, or experiments "of a physicovital kind" carried out on dead organic material (Thomas Graham) and the chemistry of excreta (William Marcet).[23] Of these it may be remarked that the chemistry of excreta seemed to hold expectation not only of adding to physiological knowledge, but likewise of explaining the excremental, or gastro-intestinal, diseases in some other terms than those of bacteriology; that medical geography and meteorology were, in a sense,

[19] *Ibid.*, p. 10.
[20] *Ibid.*, p. 75.
[21] *Ibid.*, pp. 79-80, 82.
[22] *Ibid.*, p. 87.
[23] *Ibid.*, pp. 102-103.

merely broader investigations in environmental hygiene; and that history, as exemplified by Creighton and Hirsch, aimed at the large-scale, literary survey of the geographical, meteorological, and sanitary concomitants of disease in all times and places. Richardson's varied proposals—and this is also true of his diversified work through nearly half a century—have a greater measure of unity than at first appears.

For the prevention of disease he relied on the combined effects of sanitation and salvation, on outer and inner cleansing. He proposed what might be described as the union of environmental hygiene with a sort of transcendental, or spiritual, sanitation—in short, " mental hygiene " emphasizing ethics.

> Let us drain our country on such a plan of uniformity, that every particle of pollution shall pass from our houses as it is produced there; let us cleanse our outward garments, our bodies, our food, our drink, and keep them cleansed; let us cleanse our minds as well as our garments, and keep them clean; let us isolate the contagious sick as they become contagious. Then all elaborate experiments for the prevention of disease will appear, as they are, mysterious additions to evil which ought not to exist, and which of themselves might re-introduce death into a deathless paradise.[24]

These words were written by a distinguished physician, Fellow of the Royal Society, honorary member of many foreign scientific societies, to whom problems of practical import were referred by the British Association and by other learned bodies, a man warmly praised by Allbutt, Newsholme, and MacNalty—one, in short, who was neither an outsider nor a mere obscurantist—and no ill representative of the temper of his age. It is not surprising to learn that Richardson was a pioneer advocate of the open-air treatment of tuberculosis. He suggested the advantages of village settlement—" the obtaining of a livelihood, and the hygienic treatment of the disease "—many years before the establishment of such a center at Papworth. He concluded that " with a simplified medical regime, and a strict attention to the laws of life, without which all physic is vain, consumption is not only a preventible, but, even in its second stage, a curable disease." He thought tuberculosis hereditary rather than contagious.[25] He never believed in the " germ theory " of disease.[26]

More than twenty years before the appearance of *Biological Experi-*

[24] *Ibid.*, p. 130. Cf. Richardson, *Vita Medica*, pp. 437-438, on " a new Pharmacopœia . . . Its principles are preventive, its objects wide, and its elements—some seven only, and the world's general property—are no more than *Pure air, Proper nourishment, A regulated temperature, Bodily exercise, Cleanliness, Mental education, Good morals.*"

[25] MacNalty, *op. cit.*, p. 28.

[26] *Ibid.*, p. 53. Cf. Richardson, *Vita Medica*, pp. 449 ff. (Zymosis and the Germ Theory).

mentation, Richardson's zeal for sanitary and social reform, as expressed in "Hygeia," was not unconnected with the anti-vivisection movement, just then attaining a climax. To him, and to those who thought as he did, the great alternative to animal experimentation was Chadwick's. Simon might call for the sacrifice of animals: but apart from a few exceptional experiments,[27] Richardson pinned his faith to "civilisation." Perhaps it was more than coincidence that the year 1875, which saw passage of the Public Health Act and the Artisans' Dwellings Act, also saw the appointment of a Royal Commission on Vivisection. Conscientious men had seen a vision of a healthy England, the major causes of disease swept clean away by legislation. Pollution would vanish into superlative drains —and experimental physiology with it.

The sanitary creed has been spoken of thus far as if whole and indivisible. Of course it was not. The original sanitarians, in their attack on filth, were concerned chiefly with *materies morbi* which they believed to be inhaled—foul air, the "effluvia" of dead organic matter, and "poisonous gases." The important work of Richardson's good friend and fellow-anesthetist, John Snow (1813-1859), in tracing the spread of cholera to drinking water contaminated with choleraic feces, received only qualified acceptance in his lifetime, and for long after, so that it remained possible to speak of such water as a predisposing or contributory cause.[28] There was also the broader, sociological approach to epidemiology, stemming from J. P. Frank and Cabanis, from a number of French hygienists in the later period discussed by Ackerknecht, from Alison, Cowan, and Davidson in Britain, and from the contemporary ideas of Virchow and his friends in Germany.

But whether one believed in epidemic constitutions, effluvia, ground water (Pettenkofer), fecalized water (Snow), inadequate food, clothing and housing, or in some combination of these as the primary source of disease, one was sure to agree that improvement in sewerage would bring about improvement in the nation's health. This had been the faith of Parent-Duchatelet and of Chadwick.[29] The problems of pure water supply and of sewerage had been shown to be parts of a single problem by the work of John Snow and William Budd; yet a sanitarian might take little interest in water supply and still be vastly concerned about the means to

[27] Cf. MacNalty, *op. cit.*, p. 91.

[28] *Snow on Cholera: Being a Reprint of Two Papers by John Snow, M. D., Together with a Biographical Memoir by B. W. Richardson and an Introduction by Wade Hampton Frost, M. D.* New York, 1936.

[29] Although Chadwick and his immediate followers thought sewer gases dangerous to health, they only called the louder for improved methods of disposing of excrement.

be adopted for the disposal of human ordure. Moreover, sewerage was easier to improve than the whole complex of social and economic existence. Pettenkofer, who had other ideas, was not at all opposed to this trend, but considered it overstressed, England serving as the example. " At present," he wrote in 1873, " it has become the fashion to think that the health conditions of a city are determined exclusively by good sewerage, abundant water supply and good toilets, and particularly by the introduction of water-closets." [80]

The sewer may therefore be taken as emblematic of environmental hygiene generally, in England most of all. It was no longer the source and symbol of malodorous filth: it had become the channel of many blessings. On this issue men of all shades of opinion—those devoted to piety, to agnosticism, to science, or to " culture "—were very nearly of one mind. The satirist was not far from the mark who represented Professor Kingdon Clifford reaching a measure of agreement on the question of sewers with Professor John Ruskin, although the former could prove the non-existence of God, and the latter, who was an ardent supporter of the anti-vivisection movement, despised Clifford's premises and hated both science and industry.

> " I hold it," said Mr. Saunders [Clifford], " to be one of the great triumphs of our day, that it has so subordinated all the vaguer and more lawless sentiments to the solid guidance of sober economical considerations. And not only do I consider a cotton-mill, but I consider even a good sewer, to be a far nobler and a far holier thing—for holy in reality does but mean healthy—than the most admired Madonna ever painted."
>
> " A good sewer," said Mr. Herbert [Ruskin], " is, I admit, an entirely holy thing; and would all our manufacturers and men of science bury themelves underground, and confine their attention to making sewers, I, for one, should have little complaint against them." [81]

On the one hand there was a wish to confine the medical scientists to drains and sewers, a strong belief in the virtue of outer and inner cleanliness, a conviction that health consisted almost altogether in holystone and holiness; on the other hand there existed a materialism so complete that " holy " in reality did but mean " healthy." These opposing views were reconciled on the need for improving sewers; yet only the former exalted sanitation at the expense of laboratory science. Not everyone

[80] Max von Pettenkofer, The Value of Health to a City. Trans. by Henry E. Sigerist. *Bull. Hist. Med. 10* (1941), p. 597.

[81] W. H. Mallock, *The New Republic; or Culture, Faith and Philosophy in an English Country House*, New York, 1878, p. 46. The original English edition appeared in 1877.

who loved a good sewer was an anti-vivisectionist; but with few exceptions the foes of physiology proclaimed the cloaca maxima to be the most certain route to assured good health. The Englishman had by this time developed what James Joyce has called his "cloacal obsession." [32]

Ruskin preached morality as the soul of art and the basis of life, spirituality as the strict antithesis of "sober economical considerations," of all gross mundane affairs, of dirty money and carnal medicine. The "sign sternly given" (Ruskin's phrase) that Oxford rejected his message, the proof that "whatsoever things are pure, whatsoever things are lovely" were thenceforth to succumb to materialism, was the election of a vivisectionist Professor of Anatomy. Ruskin promptly resigned his Slade Professorship of Art (1879), turning away his face from an evil thing.[33] Hygiene, yes. Experimental medicine, no. "Your hands are full of blood," the Lord had said to evildoers of old who offered many animals in sacrifice. "Wash you, make you clean" (Isaiah I: 15, 16). If washing was purification from blood guilt, cleanliness might also be looked upon as the way ordained to avoid incurring such guilt. What need for dirt and disease? What need for experimental medicine?

Ruskin sighed for the rural beauty destroyed by the tasteless building up of Croxsted Lane, once a green by-road; saw it bordered by "pits of stinking dust and mortal slime"; and could envisage no resource, no stimulus, for a child growing up in the "foul causeway," except "the thrill of scientific vanity in the primary analysis of some unheard-of process of corruption—or the reward of microsopic research in the sight of worms with more legs, and acari of more curious generation than ever vivified the more simply smelling plasma of antiquity." Moreover,

> the pleasure which we may conceive taken by the children of the coming time, in the analysis of physical corruption, guides, into fields more dangerous and desolate, the expatiation of imaginative literature: and the reactions of moral disease upon itself, and the conditions of languidly monstrous character, developed in an

[32] Cf. Michael Edwardes, Miss Nightingale and the Imperial Cloaca. *The Twentieth Century, 154* (1953), pp. 452-459.

[33] Cf. G. W. Kitchin, *Ruskin in Oxford and Other Studies*, London, 1904, pp. 48-49. Kitchin perhaps lays too much stress on a single cause of the resignation. Ruskin gave two reasons (the other was insufficiency of funds for his drawing school) and remarked that "double motives are very useful things." He was dissuaded with difficulty from devoting a lecture to an attack on science, and he insisted in the press that his complaint against vivisection had moved him to resign; nevertheless it has often appeared to his biographers that behind all the reasons given lay his realization of the failure of his powers. Cf. Sir Kenneth Clark, *Ruskin at Oxford: An Inaugural Lecture*, Oxford, 1947, pp. 21-22; Derrick Leon, *Ruskin: The Great Victorian*, London, 1949, pp. 544-45; Peter Quennell, *John Ruskin: The Portrait of a Prophet*, London, 1949, p. 297.

atmosphere of low vitality, have become the most valued material of modern fiction and the most eagerly discussed texts of modern philosophy.[33a]

The religious element in the passages quoted from *Biological Experimentation* is plain to be seen. Richardson might well have agreed with the view of his contemporary, W. R. Greg: "We have never done the Creator the wrong of doubting that the world is so constituted that if we are morally right we shall be socially and physically happy." [34] Although Sir Benjamin started life as a Calvinist and ended it with "broad views," one of his valued friends was Cardinal Manning, a leader, incidentally, in the anti-vivisection crusade, with whom he discussed a book he had in mind to write—*The Physiology of Sin*. This book was never written. MacNalty thinks "it might have supplied a scientific explanation of disorders of conduct," [35] and so it might. It might also have elaborated the theme of George Richard Jesse, a retired railway employee and Honorary Secretary of the Society for the Abolition of Vivisection, who told the Commissioners of 1875: "Folly, vice, ignorance, dirt, and selfishness create disease. To torture animals to escape the natural penalty of viciousness is ridiculous." [36] When Richardson writes about the "laws of life," it is often apparent that he is thinking of moral laws, very little different from the precepts of virtue. Outer and inner cleanliness are really one. Pain is a warning to have done with errors, sanitary or moral. It is futile to "try to master pain by entering into experimental conflict with Nature on her own ground." [37]

Richardson denounced "all elaborate experiments for the prevention of disease" as "mysterious additions to evil which ought not to exist." He was thus not far removed from the position succinctly outlined by the Birmingham Association for the Prevention of Cruelty to Animals, in a letter which was published in *Punch*, March 11, 1876:

[33a] John Ruskin, Fiction—Fair and Foul, *The Nineteenth Century, VII* (June, 1880), p. 943.

[34] Quoted by Viola Klein, in *Ideas and Beliefs of the Victorians: An Historical Revaluation of the Victorian Age*, London, 1949, p. 265. This book, by various authors, is made up of the texts of a series of talks broadcast on the Third Programme of the British Broadcasting Corporation.

[35] MacNalty, *op. cit.*, p. 74; and Richardson, *Vita Medica*, pp. 484-485. Vice causes derangement of the organism, which in turn produces vice. The example is alcoholism.

[36] *Report*, 1876 (n. 15 above) Sect. 6475, p. 319.

[37] Cf. Owsei Temkin, Health Education through the Ages. *Am. J. of Public Health, 30* (1940), p. 1093, quoting from G. G. Coulton's *Life in the Middle Ages* the underlying idea that "God predestines each human being to a certain span of life. Nothing can extend this span, but sins and follies can shorten it; only through virtue and piety can a man enjoy the full tale of years allotted to him."

> The increasing use of more and more artificial apparatus for ingeniously torturing our helpless, harmless, and innocent creatures, has been accompanied with an increasing tendency in the medical profession to approve of and promote artificial impurity in the blood and in morals; cruelty, recklessness, and impurity going hand in hand; so that we are threatened with demoralisation of a complicated order from the profession which ought simply to minister to health.

Punch betrayed his own sentiments by printing this paragraph with an anti-vivisectionist letter signed "The Old Woman," and dated "Old Lady Day."

Preventive medicine of the Chadwick pattern got rid of "impurity" and "pollution"—words much used in the pulpit and burdened with complex meanings in ordinary speech; but the preventive medicine of Jenner and Pasteur actually introduced "impurity" into the body, or worse still, into the blood, a fluid of mystic significance and the peculiar vehicle of life. With the special sexual connotation of the word, "morals," the charge was complete.[38] A healthy life was a "clean" life. Cleanliness was promoted, in their different ways, by engineers and clergymen and the pious laity; it was threatened in every aspect by degraded leaders of the medical profession, hardened as they were by the systematic practice of cruelties. Their procedures, it is worth noting, were always "artificial." Their more extreme critics, on the other hand, were generally loud in the praise of "natural" methods of healing. All this, with the same vocabulary, may be found almost unchanged in anti-vivisection literature of the present day, emanating from writers rather less distinguished than Richardson.

If this constellation of ideas, beaming forth a religious light, still shines upon us today, it shone, too, long before that impassioned anti-vivisectionist, Queen Victoria, ascended the throne of England. A wild polemic about "filthy impurities" had been directed in its time against variolation, and against the succeeding practice of vaccination. The spirit which eventually overthrew the Compulsory Vaccination Act was not merely the democratic spirit of independence which engenders resentment

[38] As a charge against the medical profession this had a quite specific meaning. According to Frances Power Cobbe, the foremost leader of the anti-vivisection movement, undue concern about the health of the body—she called it "Hygeiolatry"—led to selfishness and cowardice, and of course to vivisection; it led also to unchastity. "The Bishop of Bedford taking the chair at the meeting, May 3rd of the present year (1882), of the Social Purity Alliance, alluded to this heavy charge against the medical profession in the following terms: 'I know what doctors say, and I here publicly protest against the terrible thing that is often said by doctors to young men,—that sin is good for their health. I say God forgive those who have said it!'" (F. P. Cobbe, *The Peak in Darien*, London, 1882, p. 90).

against all forms of compulsion; it was the same spirit which animated the crusaders for the Vivisection Act. In certain sanitarians this spirit was strong.

Non-jurors to the new creed of bacteriology were fairly numerous, as might be expected, among the priests of environmental hygiene. Not all of them, however, displayed the fully developed "syndrome" described above. One who had many of the symptoms was George Wilson (1848-1921),[39] author of one of the pioneer handbooks of hygiene in English, for many years the standard manual for candidates for certificates or diplomas in public health at English universities.[40] Wilson held a number of executive positions in the various sanitary societies and institutes, and for thirty years or more was Medical Officer of Health for Warwickshire and Cambridgeshire. In the end he showed himself to be an unreconstructed Chadwickian and a half-reluctant anti-vivisectionist. The eighth edition of his *Handbook*, which for obvious reasons was the last, appeared in 1898. It contained his outspoken heterodox views on bacteriology, which he saw developing at the expense of the older hygiene, linked with unmistakable signs of anti-vivisectionist sentiment. A recent volume of anti-vivisection propaganda has in its index no fewer than twenty-seven references to Wilson, an honor in which he surpasses Miss Cobbe herself. This book quotes him as follows:

> There can be little question that the keenness of bacteriological investigations and experimentation on animal life has threatened of late years to minimize those factors of environment which, from the view of practical sanitation, still remain of paramount importance, animal pollutions or invasions of air, water and food, and reckless disseminations of contagion. . . . There are not a few who doubt whether all the agonies inflicted on animals sacrificed in the laboratories of Continental workers in bacteriological research, or even in those at home where the use of anaesthetics is enjoined, have saved one single life, or lessened in any appreciable degree the load of human suffering.[41]

In 1899, at the Portsmouth meeting of the British Medical Association, Wilson caused a sensation by re-iterating such opinions in his

[39] Cf. obituaries in the *British Medical Journal*, 1921, *2*, p. 675, and *Lancet*, 1921, *2*, p. 877.

[40] George Wilson, *A Handbook of Hygiene*, London, 1873. Later editions appeared under the title, *A Handbook of Hygiene and Sanitary Science*. Equally well known was another *Manual of Practical Hygiene* by E. A. Parkes, London, 1864.

[41] E. Westacott, *A Century of Vivisection and Anti-vivisection*, Ashington, Rochford, Essex, England, 1949, p. 156. The index contains twenty-nine references to George Wilson, but in two instances he has been confused with the author of the *Life of John Reid*. The quotations given above are from the 1898 edition of the *Handbook*. For the kindest possible review of this edition, see *Lancet*, 1898, *2*, p. 1555.

presidential address to the State Medicine Section.[42] He denounced "the indiscriminate maiming and slaughter of animal life with which these bacteriological methods of research and experimentation have been inseparably associated." Believing in the value of vaccination for smallpox, he denied that there could be any analogy whatever between Jennerian vaccination and Pasteurian. "Jenner's experimental altar was no sacrificial altar." He declared the chief factor in a recent upsurge of popular antagonism to smallpox vaccination "has been the rush of the younger men in the profession to use these antitoxin serums." The whole furor over vaccines was nothing more, he said, than a matter of commercial interests. "I say that we can only fight phthisis on the old lines, by improving heritage when that is possible, by improving the homes and conditions of life and labour which are always possible and always call loudly for interference. But this insane hunt after the tubercle bacillus, as if it could be bottled up in a twopenny-halfpenny spittoon and got rid of, is the insanest crusade ever instituted on illogical lines."

In 1906 Wilson was named to occupy a corner seat on the Second Royal Commission on Vivisection, where he cross-examined witnesses in an effort to show that sanitation and advancing civilization were doing the good work attributed to Pasteur, Koch, and Behring; he was also a cross examiner "in respect to the prevention of pain." Unwilling to be regarded as a representative of the anti-vivisectionists (he had not allied himself with any of their societies) he signed the Final Report of the Royal Commission in 1912, which recommended a few minor limitations and a general tightening of administration of the Vivisection Act of 1876. He also signed a Reservation Memorandum, going a little beyond the Report, along with the Hon. A. R. M. Lockwood and Sir William Job Collins. Finally, he submitted a lengthy Reservation Memorandum of his own, a typical anti-vivisectionist document.[43]

Wilson accepted the "germ theory" within a very limited area. He preached, as did Virchow and others, against the common ontological fallacy of the eighties and nineties. At other points, too, his criticism was sometimes shrewd. A *Lancet* editorial[44] on his Portsmouth address of 1899 suggested that "he spoke from a theoretical and not a practical knowledge" of the subject, having declared himself a close student of its *literature* ever since Pasteur had announced the results of his prophylactic inoculations. In the beginning, most doctors had been indifferent or hostile

[42] *Lancet*, 1899, *2*, pp. 379-381.
[43] An eleven-page abstract is given by Westacott, *op. cit.*, pp. 454-464.
[44] *Lancet*, 1899, *2*, p. 372.

to Pasteur, but within a dozen years this literature, which Wilson perused so dutifully, grew with the growing enthusiasm of the profession to monstrous proportions. Much of its content was monstrous too. De Bary, who was not likely to be accused of any lack of first-hand experience, complained in 1884 of the high number and low quality of bacteriological publications. "In the medical field in particular," he said, "it is at the moment absolutely impossible to follow adequately the hot chase of the bacteriological go-getters with scientific criticism." [45] In the glorious decade of the eighties, "new discoveries were being announced," as Harvey Cushing put it, "like corn popping in a pan." [46] Because so many of these announcements told of true discoveries, we are likely to forget that many more were popcorn indeed. Virus diseases, deficiency diseases, and neoplastic diseases were confidently attributed to more or less innocent microbes. There was much bad and hasty work. Some wicked, but very wily, bacteria proved hard to convict of their crimes. Furthermore, there were, and are, mysteries in the incidence and course of epidemics lending themselves readily to exploitation by hostile critics of bacteriology. There were ill effects from attempts at immunization. And there was, as Wilson and others pointed out, some tendency to neglect environmental factors of proven importance. Nevertheless, non-medical considerations underlie such unbalanced attacks as his. Ever since the "dirt theory" of disease had been taken seriously, good health in filthy circumstances had been a little hard to explain. Yet a healthy man with diphtheria bacilli in his throat was considered by old-time hygienists to be a walking refutation of Klebs and Loeffler.

Wilson found the animal experiments of the bacteriologists revolting; not less revolting, however, were the measures of prophylaxis and therapy which came to be recommended in consequence of such experiments. The "filthiness" of immunization procedures was thoroughly obnoxious to true believers in universal sanitation. It should be remembered that although the introduction of calf lymph had brought about a merger of the anti-vaccination and anti-vivisection movements, these movements were already running parallel in the days of arm-to-arm transfer; the same sort of objection had been heard in the era of variolation, when no animal problem whatever was involved. Long before the time of Chadwick, when

[45] A. De Bary, *Vergleichende Morphologie und Biologie der Pilze, Mycetozoen und Bacterien*, Leipzig, 1884, p. 529: "Zumal auf medicinischem Gebiete ist es derzeit absolut unmöglich, der Hetzjagd der Bacterienstreberei mit wissenschaftlicher Kritik ebenmässig zu folgen." This paragraph was drawn to my attention by Dr. C. F. Robinow.

[46] Quoted by C. E. A. Winslow, *The Life of Hermann M. Biggs, Physician and Statesman of the Public Health*, Philadelphia, 1929, p. 60.

filth lay undisturbed, inoculation and vivisection could be denounced in the same breath for yet another reason: both were attempts to do good (this much was often conceded) through means inherently evil. Wilson, like others of his kind, assumed this stand, but he made an exception of vaccination for smallpox. The evidence, he thought, was overwhelming. Besides, there was the comforting thought that Jenner had had no "sacrificial altar."

Not the least interesting of our sanitarian trio is the last, Sir William Job Collins (1859-1946), anti-vaccinationist, anti-vivisectionist, severe and subtle critic of the "germ theory." A surgeon and ophthalmologist of no little distinction, he "turned aside from his medical career to promote liberal reforms in the life and welfare of his fellow citizens, through a long life of service to the university, city and county of London, and to the country at large, both in Parliament and through a large number of public and private commissions and societies." [47] Merely to list his efforts and accomplishments in this way would require a page or two, evidencing in every line his ability, energy, and humanity.

It is not surprising that a surgeon should appear in the company of Richardson and Wilson. Lawson Tait, the great hygienist of the operating room, denied to the end the theory of antisepsis and declared that "the laboratory fails utterly." [48] It is well known that he was an eminent anti-vivisectionist.[49] Dr. G. G. Bantock, whose views about germs were described by Osler as "twaddle," told the Second Royal Commission on Vivisection that surgical cleanliness consists in the "absolute exclusion of dirt," because "dirt may contain some poisonous matters. We do not know, and we have no means of knowing what that poisonous matter may be." [50] However great the distance separating Tait and Bantock, both disbelieved in bacteriology and vivisection, both believed most passionately in the exclusion of dirt. The existence of a little school of (quite successful) surgical hygienists in England was, of course, one of the reasons for the tepid reception of Listerism.

It was not, however, on the question of surgical hygiene that Collins took his stand. Broader problems claimed his attention. Like Richardson

[47] D'Arcy Power and W. R. LeFanu, *Lives of the Fellows of the Royal College of Surgeons of England: 1930-1951*, London, 1953, p. 163.

[48] I. Harvey Flack, *Lawson Tait: 1845-1899*, London, 1949, pp. 88-91.

[49] *Ibid.*, pp. 69-73.

[50] Quoted by Westacott, *op. cit.*, p. 351. For Osler's use of the word, "twaddle," with reference to Bantock, see *ibid.*, p. 377. For Bantock, cf. *Royal Commission on Vivisection. Appendix to Fourth Report of the Commissioners, Minutes of Evidence, October to December, 1907*, London, 1908. Sect. 14530 ff., pp. 76-97; "twaddle," Sect. 16685, p. 164.

and Wilson he belonged essentially to the old school of sanitary science. Like them he was active in sanitary organizations. In 1887, when Wilson's *Handbook* was the standard text, Collins took the certificate of London University in sanitary science, winning a gold medal. Later in life he became president of the Sanitary Inspectors Association, a post once occupied by Richardson, and was chairman of the Chadwick Trust. " Collins was not content only to carry on the work of earlier liberals, but wrote biographies of his heroes Sir Samuel Romilly (1908) and Sir Edwin Chadwick (1924)." [51] Chadwick had been Richardson's hero, too, and he had compiled a book, *The Health of Nations,* consisting principally of excerpts from Chadwick's writings.[52]

Unlike Richardson, Collins accepted the " germ theory," although with certain important qualifications of his own which actually robbed it of much of its significance. With immunological practice, however, he would have nothing to do, taking up the cudgels as early as 1880 (the year in which he qualified) with a letter to the *Lancet* on Pasteur's experiments with chicken cholera. He asserted the principal finding with respect to this " virus " to be simply that " it is the oxygen of the air which weakens or extinguishes the virulence." Here he seemed to discover some explanation of a number of scattered facts, " the efficacy of isolation and the limitation of infection, the utility of oxidising disinfectants, the salubrity of the country and the morbidity of the town, the success of the cool or open-air treatment of certain diseases, the decline of zymotic disease before the progress of sanitation, and many others. . . . What, then, are the inferences to be drawn from these facts? [Thiersch, Burdon Sanderson, and others had been cited as well as Pasteur.] Do they warrant the inoculation of all persons with the attenuated viruses of all zymotic diseases with a view to prophylaxis? Do they not rather establish a stronger plea for extended sanitation, for the means of fighting diseases outside our bodies and not within them, for making our hygiene so good that prophylactics and antiseptics shall be superfluous? " [53] Forty years later Collins reiterated this plea, quoting the very words he had used at the beginning of his career.[54]

[51] Power and LeFanu, *loc. cit.* See W. J. Collins, *Sir Samuel Romilly's Life and Work* London, 1908; *The Life and Doctrine of Sir Edwin Chadwick,* London, 1924 (cf. *Lancet,* 1924,1 : 831, 882).

[52] B. W. Richardson, *The Health of Nations: A Review of the Works of Edwin Chadwick, with a Biographical Dissertation,* 2 vols., London, 1887.

[53] *Lancet,* 1880, *2,* p. 913 (Dec. 4, 1880).

[54] *Lancet,* 1920, *1,* p. 1059 (May 15, 1920). The source is mistakenly given as the *Lancet* issue (non-existent) of Nov. 16, 1880.

Wilson, who shared these views, made an exception of Jennerian prophylaxis. Not so Collins. As a member of the Royal Commission on Vaccination (1889-1897) he refused to sign the Commission's *Report* but joined instead with J. Allanson Picton in a "Statement . . . of the Grounds of their Dissent." This statement included evidence that "social position and sanitary environment have a potent influence on the prevalence as well as on the fatality of smallpox." [55] Although the dissentients relied chiefly on isolation, notification, disinfection, and quarantine for the prevention of smallpox, they also recommended "attention to general sanitation—prevention of over-crowding, abundant water-supply, and frequent removal of refuse." [56] Vaccination they condemned.

It was in 1884 that Collins published his most notable book, *Specificity and Evolution*.[57] This small volume, dedicated to Herbert Spencer, elaborated a suggestion put forth in a letter to the *Lancet* of 1881 and was the text of an address delivered at the Abernethian Society of St. Bartholomew's Hospital in the year of publication. For the rest of his life its author continued to dwell upon the same theme in a series of papers and addresses, some of which achieved separate publication. What follows is drawn from his own summary of his extended effort, "Specificity and Evolution in Disease: A Historical Retrospect," which appeared in 1920.[58]

Observing that "the importance of the principle of specificity in disease has been clearly and generally recognized since the time of Laennec and Bretonneau," Collins proceeded to attack this principle, in his letter of 1881, from an evolutionary viewpoint.

> Since, as regards the organic world, we have come to speak of an origin of species, and learnt to trace their differentiation under the influence of evolution to the eventual survival of the fittest, should not our views concerning specificity of diseases undergo a similar modification? Is not the theory of specificity swallowed up in the larger theory of evolution? . . . Starting from a non-specific inflammation or fever, may there not arise therefrom under favourable conditions an inflammation or a fever different from the present stock and capable of reproducing

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[55] *A Report on Vaccination and Its Results Based on the Evidence Taken by the Royal Commission During the Years 1889-1897*, vol. I, London, 1898, pp. 454 ff.

[56] *Ibid.*, p. 481. In 1855 Richardson had urged the registration of all diseases, and had even made a start in the collection of data through correspondents of the *Sanitary Review*. Cf. MacNalty, *op. cit.*, p. 49.

[57] W. J. Collins, *Specificity and Evolution*, London, 1884; 2nd edition 1890; 3rd edition 1920. Other books of somewhat similar import were *The Man versus the Microbe*, Redhill, 1903; 2nd edition 1929; and *Physic and Metaphysic*, London, 1905.

[58] See above, n. 54. Slight changes in punctuation have been introduced in quoting. Cf. also Sir William J. Collins, The Man versus the Microbe, *Lancet*, 1920, *2*, 1183-1184.

itself? I think so. . . . The common ancestry of specific diseases, once recognized, would do much to remove the hard-and-fast line so often drawn between disease and disease in textbooks and dissertations, but of which nature knows nothing.

Collins was not the first, nor even the first writing in English, to introduce the concept of evolution into the realm of bacteriology;[59] and behind all this lay an extensive literature, reaching at least as far back as Sydenham, on changes of type in epidemic disease. Shorn of evolutionary trimmings, what Collins had to say was nothing new. If he owed the manner of his presentation to Darwin, and especially to Spencer, he was also well within the tradition of Broussais. As already noted, the bacteriologists, in helping to unveil the nature of specificity,[60] had given much encouragement to the cruder forms on ontology derided by Virchow. It is interesting to note that in 1848 Virchow believed in a genetic relationship between his Upper Silesian typhus (our typhus) and the "abdominal typhus" of Berlin (our typhoid), the difference depending on the "local social situation."[61] Virchow's critical, but not unfriendly, attitude to the bacteriologists has been expounded with admirable clarity by Ackerknecht. It depended in part on an anti-contagionist background, and something of this sort may perhaps be discerned pretty widely among those who believed in the easy variability of disease, or who were, in some degree, opposed to the "specificists." But whereas Virchow was a critic of bacteriology, Collins was really its foe, and the difference was very great.

Specificity and Evolution reached the following conclusions:

Starting from ***common ancestral conditions***, we arrive at ***specific diversities***, and that the chief, if not the only, element in determining specificity is the ***nature of the soil***, in which the poison (whatever be its nature) grows, that is to say, the ***predisposition of the individual***. That the predisposition varies with the departure from a state of health, local or constitutional, but that just as in some cases so great is the virulence of the poison ***as the result of cultivation on suitable soil***, that it may even overstep the usually sufficient barriers of health and attack the unpredisposed, so, on the other hand, predisposing and exciting causes being, as it were, complementary, predisposition may be so strong that, apart from contagion, it may develop disease ***de novo***, such disease, however, as with nascent species generally, being more plastic, less fixed than the more cultured variety, and often appearing in aberrant form.

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[59] Cf. references given by W. H. Hamer, *The Milroy Lectures on Epidemic Disease in England—The Evidence of Variability and of Persistency of Type*, London, 1906.

[60] Cf. Knud Faber, *Nosography in Modern Internal Medicine* New York, 1923, Part IV.

[61] Cf. Erwin H. Ackerknecht, *Rudolf Virchow: Doctor, Statesman, Anthropologist*, Madison, 1953, p. 124.

The same notions were applied to local inflammations, "the evolution of specific local lesions from the different stages of a common or simple inflammation, as, for instance, the various classes of skin diseases, erythemata, papulae, vesiculae, pustulae, and squamae, from the stages of redness, pimple, blister, pock, and scab of inflammation. . . ." The essay closed on a hygienic note, asserting that

> filthy conditions and the imperfect removal of effete material, without and within the body, are the factors of zymotic pestilence, which aforetime walked in darkness, but is now made plain by the revealing light of science. And just as the evolution theory of disease asserts the origin of disease so does it foresee the possibility of its abolition, at any rate so far as zymotics are concerned, while it was an integral part of the old specific theory to affirm that disease was from everlasting to everlasting, as it was in the beginning it is now and ever shall be, and that salvation could only be purchased by the propitiating influence of a previous attack.

This was in harmony, as Collins himself observed in 1920, with the plea for "extended sanitation, for the means of fighting diseases outside our bodies and not within them, for making our hygiene so good that prophylactics and antiseptics shall be superfluous," which he had argued in 1880, although in 1884 he apparently planned an attack on "effete material" without and within; nor was the inner sanitation to be spiritual.

In an address of 1889 (also summarized in 1920) Collins scored some palpable hits on the ontologists. "The *raison d'être* of fission fungi in the minds of some pan-spermists would appear to be the infliction on mortals of exanthematic disease; for such purpose they hold they are and were created. Whereas I apprehend the truer view to be that it is just so far as living tissues under certain conditions afford suitable soil for their growth and multiplication that there is any relationship between the two. . . ." But he also ran through a list of specious objections to the "germ theory" which were the commonplaces of those who fought it. The facts, he submitted, "do not warrant our insisting that the acceptance, within limits, of the bacterial hypothesis for certain diseases implies a strict acquiescence in the truth of a rigid specificity. . . . The dissemination of fission fungi may be rather epiphenomenal than of the nature of a predestinated cause."

> It is impossible at the present time to go further than to allow that the influence which makes for disease is in some instances associated with the growth of fission fungi in the body. How vast and incomprehensible may be the potentiality vested in a minute morphological unit we know in the phenomena which follow the interaction of ovum and spermatozoon; of the intimate nature of contagion we know but little more. Yet if it be true that in the life-history of the lowest of organic things lie the momentous influences which determine plagues and pestilences, it is

reasonable to believe that in organisms whose cycle may be less than an hour, and whose rate of propagation is incalculable, evolution must be powerfully at work eventuating in the survival of those most fitted to their environment, and that in this as in other directions man's influence may modify natural selection, and by acting in accordance with law learn to conquer nature by submitting to her.

That " evolution must be powerfully at work eventuating in the survival of those most fitted to their environment " is a view which has been confirmed in special ways in the realm of microbiology, notably by André Lwoff.[62] The more important inferences drawn by Collins hardly follow. Pathogens are not so mutable and inconstant as he supposed. They exhibit that contrast of variability and persistence long ago pointed out in other domains by Huxley. Striking changes in morphology may entail little if any change in pathogenicity. It is nevertheless possible that some of the mysteries which still confront the epidemiologists may have to be explained, as a number have been explained already, in terms of bacterial mutation. Epidemiologists who have been much concerned with these problems, and especially those interested in historical epidemiology, like F. G. Crookshank and Sir William Hamer, have looked with no unkindly eyes on the writings of Sir William Job Collins.[63] More recently, of course, the selection of organisms resistant to penicillin and similar drugs has attracted much attention.

The value of Collins's interesting, if speculative, contributions lay in the pointing out of problems yet unsolved, the needling of complacencies and dogmatisms. This function he shared with critics better informed and fairer minded than he. But his work also had a specific value in focussing attention on a real scientific problem. It is doubtful, however, if those capable of shedding light upon the question through research were in any way influenced by Collins. Such value as his notion had was considerably lessened by the use to which he put it. For him, it was a stick to beat the bacteriologists. His counsels to laboratory science were in sum the counsels of despair. He was not discernibly interested in the use of bacteria for studying evolution in progress.[64] He was not really interested in what the laboratories might learn about the control of disease by adopting an evolutionary viewpoint. His assurance that " man's influence may modify natural selection " was in no sense a parallel to

[62] A. Lwoff, *L'Évolution Physiologique*. Paris, Hermann, 1943. (*Actualité Sci. Coll. Microbiol.*) This is a work known to me only by reputation. In the last decade the literature of bacterial evolution has become extensive.

[63] Cf., e. g., Sir William Hamer, *Epidemiology Old and New*, London, 1928.

[64] For an interesting semi-popular account, see Francis J. Ryan, Evolution Observed. *Scientific American*, October, 1953, pp. 78-82.

modern expressions of a similar hope.[65] For Collins, man's influence was to be nothing more than sanitation—sanitation, it is true, in the broadest sense—the improvement not only of water supply and sewerage but also of food, clothing, housing, hours of work, and social circumstances in general. These changes were to lead—as undoubtedly they would and do lead—to the promotion of health. Health is a bad environment for disease. *Sanitas* would therefore beget *sanitas*. Meanwhile the external environment would become discouraging to pathogenic organisms as such. Greatly dispirited by man's inhumanity to microbe, they would evolve in other directions. In the interval before this happy change, isolation, notification, and quarantine would put immediate limits on their freedom of action, and simple, old-time sanitation would do the rest. How large a place was reserved for sanitation in this narrower sense—a place so large one is justified in calling the whole program sanitary—is shown by a paper with the significant title, "The Chadwick School of Thought; An Appeal from the New Sanitarians to the Old," read to the Congress of the Sanitary Institute at Exeter in 1913.[66]

To complete his chaplet of heterodoxy, Collins adopted the views of the anti-vivisectionists. Like Wilson, he was a member of the Second Royal Commission on Vivisection. Together they signed a Reservation Memorandum, which also bore the signature of Col. Lockwood. The whole story may be read in this Memorandum, and in the verbatim evidence published with the Report itself. Copious extracts are supplied by Westacott.

Collins was stubborn, opinionated, and brave. He never backed away from an unpopular position. He "came to disbelieve in the value of vaccination and vivisection, and as he always had the courage to speak and write vehemently in support of his beliefs, he spoilt his chances of promotion in his own hospital [St. Bartholomew's], where he had been educated in the strictest traditions of Harvey and Jenner."[67] His political and official career was probably little hampered—it may even have been helped—by his medical heresies. His labors in better causes are worthy of remembrance. They were arduous and useful and were inspired by genuine political liberalism.

One of the commonplaces of the anti-vivisection literature of Victorian

[65] Cf., e. g., Werner Braun, *Bacterial Genetics*, Philadelphia, 1953: pp. 220-221: "Improved recognition of the specific nature of . . . selective host factors may ultimately permit a novel adjunct to therapeutic measures, namely the artificial creation of an *in vivo* environment favoring the establishment of innocuous, avirulent mutants."

[66] *J. Roy. San. Inst. 34* (1913-14), pp. 315-337.

[67] Power and LeFanu, *loc. cit.*

times was the glad assurance that moral progress—moral evolution, as it was often called—would make animal experimentation unthinkable. Believers in the prepotency of "civilisation" were equally confident that social evolution, guided by sanitarian principles, would reduce disease, certainly epidemic disease, to a negligible quantity. It fell to Sir William Job Collins to round out the argument by bringing in bacterial evolution. Moral evolution making vivisection impossible, social evolution and bacterial evolution were to make it needless.

The Chadwick tradition, and the English public health movement to which it gave rise, are among the greatest glories of British medicine. The nineteenth century, the age of great industrial development and runaway urbanization with their attendant sanitary problems, the age of the appalling gastro-intestinal epidemics, had every reason, as have we, to revere the name of Chadwick. The sanitarian creed, however, eventually became, in certain instances, rigid and exclusive. For the reasons set forth above, some of its most eminent leaders sought to flush the newer science into newly constructed drains, as yet another form of pollution and wickedness.

This study has been devoted exclusively to the later development of environmental hygiene following the lead of Chadwick and Southwood Smith. Is it possible that the elements here described were also present, however undeveloped, in the first beginnings? Perhaps there were more things in sanitary science than were dreamt of in the philosophy of Jeremy Bentham.

The value for health of hygienic measures is quite beyond dispute. To fight contagious disease wherever possible outside the human body is clearly desirable, and advances in this direction have not been wanting. Perhaps the most striking of these in recent years has been the use of the newer insecticides in the control of typhus and malaria. By and large, however, progress in the control of such diseases, whatever the measures applied in the field, has been dependent at every stage on the studies of the bacteriologists and immunologists. At the same time, the social and economic factors which affect the patterns of morbidity and mortality have received increasing attention. Here, again, the old empirical foundations no longer seem firm enough: it is inconceivable that laboratory science should be left out. Environmental hygiene, in the various senses of the term, has become more and more the concern of physiologists, biochemists and biophysicists, as well as of epidemiologists and medical sociologists. The aim of some of the older hygienists, even those who occupied themselves with the social milieu in general, was to separate themselves from

biological science, to wash it down the drain. Their own proposals were frequently good, when not vitiated by wilful ignorance, but they were unfortunately exclusive. The non-medical pietistic elements were too strong. Medicine was interpenetrated with anti-medicine, science with anti-science. This assortment of ideas, which found its most eloquent literary expression in the writings of George Bernard Shaw, is widespread still.

PROBLEMS IN THE APPLICATION OF STATISTICAL ANALYSIS TO QUESTIONS OF HEALTH: 1700-1880 *

GEORGE ROSEN **

The application of the numerical method to the analysis of social phenomena in the seventeenth century initiated a development of first rate importance, destined to prove extraordinarily fruitful for the study of health and disease. The doctrine of mercantilism provided the framework of ideas in terms of which the numerical method was directed and applied.[1] Initially therefore, those who undertook to use this approach concerned themselves chiefly with what might be called the bookkeeping of the state. Efforts were made to ascertain the basic quantitative data of natural life in the belief that such knowledge could be used to increase the power and prestige of the state. Characteristically, this new field of endeavor was given the name of political arithmetic.

The father of political arithmetic was William Petty, who invented the term and was keenly alive to the importance of a healthy population as a factor in national opulence and power. This characteristic orientation is clearly revealed whenever he deals with matters of health, in his discussions of population, and in his various statistical proposals. Repeatedly, Petty urged the collection of numerical data on population, education, diseases, revenue, and many other topics. Full of the idea that analysis of such data could throw light on matters of national interest and policy, he employed mathematical calculations wherever possible. While Petty recognized the importance of a quantitative study of health problems, and suggested many topics for investigation, the first solid contribution was made by his friend John Graunt, whose classic book entitled *Natural and Political Observations . . . upon the Bills of Mortality* appeared in 1662. Taking the figures showing the number of deaths in London during the preceding third of a century, Graunt interpreted them by inductive reasoning, demonstrating the regularity of certain social and vital phenomena and bringing to light a number of important facts. Thus he noted that deaths due to various physical and emotional disorders, and even to certain accidents, "bear a constant proportion unto the whole number

* Read at the twenty-seventh annual meeting of the American Association of the History of Medicine, New Haven, Connecticut, May 6, 1954.

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[1] George Rosen: Medical Care and Social Policy in Seventeenth Century England, *Bull. N. Y. Acad. Med.*, 2nd ser., 29: 420-437, 1953.

of burials." [2] Graunt also pointed out the excess of male over female births as well as the eventual approximate numerical equality of the sexes; the ratio of births to deaths in city and country, and the excess of the urban over the rural death rate; and the variations of the death rate by seasons. Finally, Graunt made the first attempt to construct a life table.

These discoveries clearly merit high praise, but they are overshadowed in significance by the fact that Graunt's work contains the beginnings of statistical methods of analysis. He recognized that the accuracy of mathematical deductions from data must inevitably be limited in one way or another by the adequacy and precision of the observations themselves. The evident defects of the scanty and imperfect materials available to him led Graunt to test the reliability of his data. As a result he was able to show that even imperfect data, if carefully, logically, and honestly interpreted could be made to yield useful information.

Based upon the promising beginning made by Graunt and Petty, the cultivation of political arithmetic, "the art of reasoning by figures upon things relating to government" [3] was continued during the seventeenth and early eighteenth centuries, notably by Gregory King, Charles Davenant, Edmund Halley, John Arbuthnot, and Sebastien de Vauban. The hopes of the period were clearly stated by Arbuthnot in his *Essay on the Usefulness of Mathematical Learning*, issued early in 1701.

> Arithmetic is not only the great instrument of private commerce [he observed], but by it are (or ought to be) kept the public accounts of a nation; I mean those that regard the whole state of a commonwealth, as to the number, fructification of its people, increase of stock, improvement of lands and manufactures, balance of trade, public revenues, coinage, military power by sea and land etc. Those that would judge or reason truly about the state of any nation must go that way to work, subjecting all the forementioned particulars to calculation. This is the true political knowledge. In this respect the affairs of a commonwealth differ from those of a private family, only in the greatness and multitude of particulars that make up the accounts. Machiavel goes this way to work in his account of different estates. What Sir William Petty and several other of our countrymen have wrote in political arithmetic, does abundantly show the pleasure and usefulness of such speculations. It is true, for want of good information, their calculations sometimes proceed upon erroneous suppositions; but that is not the fault of the art. But what is it the government could not perform in this way, who have command of all the public records.[4]

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[2] John Graunt: *Natural and Political Observations . . . upon the Bills of Mortality*, in William Petty: *Economic Writings*, edited by C. H. Hull (2 vols.), Cambridge, England, University Press, 1889, vol. 2, p. 352.

[3] Charles Davenant: *Discourses on the Public Revenues, and on the Trade of England*, London, 1698, p. 2.

[4] G. A. Aitken: *The Life and Works of John Arbuthnot*, Oxford, 1892, pp. 421-422.

During this period the basic political and economic importance of population was an axiom of statecraft, and any impairment of this resource was a matter of high concern. Population was therefore a central object of political arithmetic, and ingenious endeavors were made to calculate the size and to determine the state of various populations. Interest was directed to various factors, including disease, that might cause the number of people to increase or decline. For the most part, however, the attempt to apply quantitative thought to population problems and related matters made little substantial progress. Working with inadequate information, the political arithmeticians were rarely able to avoid the temptation to juggle the scanty numerical observations, or to use imagination where facts were lacking. Nevertheless, this period is characterized as well by practical and theoretical contributions pregnant with future significance.

On the practical side this is true of the life, or mortality table. Graunt's crude effort found a favorable response in other countries, and within a generation of his death businessmen were endeavoring by its use to put life insurance on a sound basis. In 1669, seven years after the publication of Graunt's work, Christian Huygens had already taken up the problem of determining mathematically the probable expectation of human life at any given age. More valuable, however, was the life table published in 1693 by Edmund Halley. This table was directly applicable to the calculation of life annuities, and it is worth noting that the first life insurance companies established in London in the eighteenth century made use of Halley's table. The sound operation of any life insurance plan presupposes knowledge of the rates of mortality and life expectancy, and as the century progressed some improvements were made in the construction of such tables with the result that insurance operations were placed on sounder actuarial lines. This development was likewise fostered by those interested in helping the poor provide for themselves through voluntary sickness insurance schemes, so-called friendly societies. Finally, after the middle of the century, the life table found some application in attempts to test the efficacy of inoculation against smallpox.

On the theoretical side there was the first intimation that the calculus of probability might be applied to the study of political arithmetic. During this period the calculus of probability was being developed by a number of distinguished mathematicians. In 1713, following the pioneer work of Pascal, Fermat, and Huygens, there appeared *Ars Conjectandi*, the im-

For another reaction to political arithmetic see Jonathan Swift: *A Modest Proposal for Preventing the Children of Poor People from Being a Burthen to their Parents, or the Country, and for Making them Beneficial to the Publick*, Dublin, 1729.

portant posthumous work of Jakob Bernoulli, in which he developed the mathematical theory of probability and set himself the problem of applying it to "civil, moral and economic conditions." Bernoulli's work was followed in 1716 by the *Doctrine of Chances* of Abraham De Moivre, a French Huguenot who settled in London after the revocation of the Edict of Nantes in 1685. In 1724, he suggested the empirical rule, that between the ages of 12 and 86, the number of living persons declines in an arithmetical progression with increasing age. This rule was applied to, and for a considerable time influenced the construction of mortality tables. It should be noted, however, that for the most part writers on the calculus of probability paid scarcely any attention to the frequencies presented by actual statistical material.

Nevertheless, the inherent potentialities of the mathematical theory of probability in relation to vital phenomena were recognized early in the eighteenth century by John Arbuthnot, the Scottish physician, satirist, and mathematician, whose name has already been mentioned. In a short essay entitled *Of the Laws of Chance*, which appeared anonymously in 1692, he wrote:

> There are very few things which we know, which are not capable of being reduced to a mathematical Reasoning and when they cannot, it is a sign the Knowledge of them is very small and confused; and where a Mathematical Reasoning can be had, it is as great Folly to make use of any other, as to grope for a Thing in the Dark, when you have a Candle standing by you. I believe the Calculation of the Quantity of Probability might be improved to a very useful and pleasant Speculation, and applied to a great many Events which are accidents, besides those of Games; only these Cases would be infinitely more confused, as depending on Chances which the most Part of Men are ignorant of.[5]

In 1710, in *An Argument for Divine Providence, taken from the Constant Regularity Observed in the Births of Both Sexes*, Arbuthnot employed the technique of mathematical probability to prove that the approximate numerical equality of the sexes in adults is "not the effect of Chance but Divine Providence working for a good End," namely, "that the Species may never fail, nor perish, since every Male may have its Female, and of a proportionable Age."[6]

Arbuthnot did not carry further his use of probability, but his demonstration of providential design indirectly helped to advance the development of statistical method. In 1713, William Derham published his Boyle

[5] Lester M. Beattie: *John Arbuthnot, Mathematician and Satirist*, Cambridge, Mass., 1935, p. 338.

[6] *Ibid.*, p. 339.

lectures delivered in 1711 and 1712 under the title *Physico-Theology; or a Demonstration of the Being and Attributes of God from his Works of Creation.* As the title indicates, this work is an elaborate argument for the wisdom of God in the Creation. In a chapter on the "Balance of the Animal World," Derham discussed the balance of the sexes using Graunt's statistics. "That this is a work of the Divine Providence." he said, "and not a Matter of Chance, is well made out by the very Laws of Chance, by a Person able to do it the ingenious and learned Dr. Arbuthnot." It was a perusal of Derham's book which stimulated Johann Peter Süssmilch to undertake the studies of population that eventuated in the publication in 1741 of his detailed work *Die göttliche Ordnung.* In the preface to his second edition (1761) Süssmilch listed Arbuthnot and Derham, together with Graunt, Petty, and King as his forerunners.[8] While Süssmilch had none of the brilliance or originality of a Petty or a Graunt, his earnest and diligent pursuit of his arithmetical investigations did lead to a distinct advance in method. He recognized that only by considering large numbers of cases could he obtain the mathematical regularities and the constancy in results which to him represented "the divine order." Süssmilch was fully aware of the need for accurate data, and even suggested that if the Latin names of diseases were used in reporting, international comparisions might be possible.

The need for accurate numerical data concerning the people of a country was increasingly recognized in the eighteenth century and attempts were made by several European states to determine the numbers of their populations and their characteristics. France was the first modern European state to call statistics to the aid of government. The practice of collecting statistical data had been established by Colbert. It was not, however, until the end of the seventeenth century, in 1693, that a general survey of the population of France was undertaken.[9] A few years later, in 1697, the *Intendants* were asked to prepare historical, political, economic, and demographic descriptions of their *Généralités.* This survey was completed by 1700 and forms the basis of almost all French population studies during the first half of the eighteenth century. Vauban helped

[7] William Derham: *Physico-Theology: or, A Demonstration of the Being and Attributes of God, from His Works of Creation,* 5th edition, London, 1720, p. 176.

[8] Johann Peter Süssmilch: *Die göttliche Ordnung in den Veränderungen des menschlichen Geschlechts, aus der Geburt, dem Tode und der Fortpflanzung desselben erwiesen,* Dritte verbesserte Ausgabe, Berlin, 1765, Erster Theil, p. III. The preface of the second edition is reprinted in the third edition.

[9] Paul E. Vincent: French Demography in the Eighteenth Century, *Population Studies* 1: 44-71, 1947-48.

draw up the questionnaire which was sent to the *Intendants*. In his *Dîme royale*, he devoted a chapter to the usefulness of demographic surveys, going into considerable practical detail as to their organization, and urged that they be undertaken annually. Various public officials continued to be interested in population questions, but active concern with such problems was again aroused following the publication in 1756-58 of Mirabeau's book *L'ami des hommes*, in which he expressed the opinion that the French population was declining. In consequence, a number of significant studies appeared during the latter half of the eighteenth century. Worthy of special mention are the publications of d'Expilly, La Michodière, and Montyon. Indeed, La Michodière's efforts actually bore fruit to the extent that detailed vital statistics by *Généralité* began to be published regularly each year from 1786 on in the *Mémoires de l'Académie des Sciences*. Unfortunately, this work was soon interrupted and it was not until the nineteenth century that the first effective census was carried out in France.

It was Sweden, which first gave political arithmetic a solid basis through the collection of official population statistics.[10] Based upon a study by Per Elvius, mathematician and secretary to the Swedish Academy of Science, legislation was approved in 1748 requiring the parish clergy to prepare tabular records of the population. These tables were eventually sent to the central government where they were condensed into a general summary for the entire country. This summary was prepared by a committee which in 1756 was made a permanent institution called the Tabular Commission. The most active member of the Commission was Per Wargentin, astronomer and successor of Elvius as secretary of the Academy of Science. The data collected by the Commission were not published, however, until after 1762. Like other states of the period, Sweden considered information on population as a secret to be hidden from potential enemies on grounds of political security. Gradually this policy was relaxed and during the following years various important reports were published. In 1766, for example, Wargentin published his mortality tables for the nine years 1755-63. Based on observation of the living population as well as on deaths, these were the first mortality tables for an entire country.

It should also be noted that the constitution of the United States provided for a decennial census, and that the first census was carried out in 1790 by direct enumeration. Enumerations had been taken even earlier

[10] Harold Westergaard: *Contributions to the History of Statistics*, London, 1932, pp. 53-60.

in specific colonies, for example, in Connecticut in 1756 and in Massachusetts in 1764.

Britain and the Germanies lagged behind Sweden and France in the official collection of population statistics. In England various private individuals continued to make observations on vital statistics and to calculate estimates of population. On the basis of such data, mortality tables were constructed. Among the best known of these are Northampton Table of Richard Price and the Carlisle Mortality Table drawn up by Joshua Milne upon John Heysham's study of vital statistics at Carlisle.[11] Private efforts to collect and compare vital statistics also characterize the situation in the German states.[12] While official censuses were undertaken quite regularly, as in Prussia under Friedrich II, and the clergy were required to maintain registers of births, deaths, and marriages, these materials were not subjected to analysis by any public agency. Throughout the eighteenth century it was left to the initiative of interested private individuals to publish these materials and to draw conclusions from them. Early in the century two physicians, Johannes Daniel Gohl and Johannes Christian Kundmann, began to issue lists of deaths with causes for given years arranged according to months. A much larger collection of German and foreign data was offered in 1741 by Süssmilch, whose work is actually a fairly complete compendium of all the statistical literature available at that time.

While promising public and private efforts were made to compile numerical data, the full effect of these endeavors was not to be felt until the nineteenth century. At this point it may be worthwhile to ask what the political arithmeticians of the seventeenth and eighteenth centuries had achieved. To what extent had the high hopes of Petty, Graunt, and their immediate successors been fulfilled? On the one hand, it should be made quite clear that the political arithmeticians had accumulated considerable knowledge. For example, they knew there were regularities in the phenomena of vital statistics, they were aware of the balance of the sexes, and they recognized that mortality differed under a variety of conditions. On the other hand, much of this knowledge was vague and imprecise. Because no solid factual base derived from exact investigation was available in

[11] Richard Price: *Observations on Reversionary Payments* . . . 3rd edition, London T. Cadell, 1773, pp. 259-270; Carl B. Cone: *Torchbearer of Freedom, The Influence of Richard Price on Eighteenth Century Thought*, Lexington, Ky., 1952, pp. 39-45; Henry Lonsdale: *The Life of John Heysham, M. D., and his Correspondence with Mr. Joshua Milne, relative to the Carlisle Bills of Mortality*, London, 1870.

[12] Alfons Fischer: *Geschichte des deutschen Gesundheitswesens*, Berlin, 1933, Bd. II, p. 35-36, 105-109.

many instances, the conclusions drawn by political arithmeticians were frequently ill-founded and premature. Adam Smith probably expressed the opinion of many of his contemporaries with his statement " I have no great faith in political arithmetic." [13]

This situation was due not only to the inadequacy of the available data, but also to a lack of proper methods for dealing with them. A modern work on statistics is concerned in large measure with methods of evaluating errors of sampling, that is, with techniques which will enable the investigator to test the data thoroughly for bias so that this factor may be taken into account in any inferences to be drawn from the material. In the eighteenth century, however, such methods were not applied; in fact, they were just beginning to be developed. A few investigators were keenly aware of the importance of this problem. In 1781, for instance, William Black, a physician, published his *Observations Medical and Political on the Small-Pox . . . and on the Mortality of Mankind at every Age in City and Country*. Alive to the significance of statistical method, he commented that " the detached observations of physicians or other literary individuals, confined perhaps to a small town or parish: a meagre detail of village remarks (*sic*), afford in many instances a foundation too slight to erect upon them any general or permanent conclusions." [14] Accordingly, Black subjected the London Bills of Mortality to critical examination, and proposed the creation of a public office, manned by a salaried staff with medical knowledge, where vital statistics would be recorded.

Although Black recognized the significance of bias arising from inadequate sampling, he did not broach the problem of securing a proper sample or of controlling the results. However, an important step in this direction was taken by Laplace, the famous mathematician. In 1786, he proposed to estimate the French population from the birth rates in a selected group of representative districts. Furthermore, Laplace outlined a method for assessing the accuracy of the result by determining the probable limits of the deviation from the true numbers.

This important contribution by Laplace was not, however, the first attempt to apply more precise mathematical methods to vital phenomena. This had already been tried earlier in the century in the course of endeavors to test the efficacy of inoculation against smallpox. The merits of inoculation provided the subject matter for heated controversy during

[13] Adam Smith: *An Inquiry into the Nature and Causes of the Wealth of Nations*, edited by Edwin Cannan, New York and London, 1904, vol. II, p. 36.

[14] Cited in Major Greenwood: *Medical Statistics from Graunt to Farr*, 1948, p. 64.

the greater part of the century, and it was in relation to this practice that the first attempts were made to determine by statistical means the value of a prophylactic measure. As early as 1722, two physicians, Nettleton and Jurin, the latter secretary to the Royal Society, endeavored to prove the value of inoculation by demonstrating that there was a greater risk of dying from smallpox than from inoculation.[15] Süssmilch discussed this burning problem in 1741 and tried to show the value of the method by calculating that an inoculated individual is 25 times less likely to die of smallpox than one who had not submitted to variolation.[16] These attempts led to no useful results because none of the investigators took into account the population at risk and the actual incidence of smallpox in this population. A more significant approach to the problem was made in 1760 by the mathematician Daniel Bernoulli. In an essay communicated to the Royal Academy of Science in Paris, he undertook to analyze the mortality caused by smallpox and to show the advantages of inoculation as a preventive measure.[17] Bernoulli was not so much concerned, however, with the biological question of inoculation as with the mathematical problem of obtaining a measure of the influence of a specific disease on the duration of life. In other words, his problem was to determine how many years would be added to the average life span if smallpox were eliminated as a cause of death. For this purpose, the question of the comparative risks of death from smallpox and from inoculation appeared to offer a suitable subject. The method employed by Bernoulli was to compare the age distributions and the mean durations of life in two different populations. The one was the existing population with its high mortality due to smallpox; the other, an imaginary population freed from the mortality caused by smallpox. For this comparison he employed Halley's life table to represent the actual population and a hypothetical table to show how many survivors there would be at each age, if there were no mortality from smallpox. By using infinitely small units of time, Bernoulli was able to consider mortality as affecting the population continuously, and to deal

[15] Dr. Nettleton: Concerning the Inoculation of Small-pox, and the Mortality of the Distemper in the Natural Way, *Philosophical Transactions* 32: 209, 1722;; James Jurin: A Comparison between the Danger of the Natural Small-Pox and of That Given by Inoculation, *Philosophical Transactions* 32: 191, 213, 1722.

[16] Süssmilch, *op. cit.*, vol. II, p. 440.

[17] Daniel Bernoulli: Essai d'une nouvelle analyse de la mortalité causée par la petite vérole et les avantages de l'inoculation pour la prévenir, *Histoire de l'Académie Royale des Sciences, année 1760, avec des mémoires de mathématique et de physique pour la même année*, Paris, 1766; M. Noel Karn: An Inquiry into Various Death-Rates and the Comparative Influence of Certain Diseases on the Duration of Life. I. Introduction. Historical, Statistical and Mathematical, *Annals of Eugenics* 4: 279-302, 1931.

with the mortality due to a particular disease, in this case smallpox, apart from that due to other causes. The results of this study were expressed as the solution of a differential equation. At the time, Bernoulli's method could not find any practical application, since this could be accomplished only by having accurate data which were not available. Almost fifty years later, however, the method was taken up again by E. E. Duvillard, a Swiss, interested in a similar problem, namely, to determine the influence of vaccination against smallpox on mortality at different ages.[18]

The last years of the eighteenth century, and the early decades of the nineteenth century have all the earmarks of a period of transition. The era opened up by Graunt and Petty was nearing its close, but the curtain of time had not yet risen sufficiently to reveal in detail the period of Quetelet and Farr which was to follow. Indeed, the very name political arithmetic was being replaced at this time by a new term, statistics, which had first been employed in 1749 by Gottfried Achenwall to designate the descriptive analysis of the political, economic, and social organization of states.[19] It is worth noting that in 1817, when the French Academy of Science proposed a prize to encourage statistical studies, statistics was defined as a "science of facts," concerned solely with collecting the numerical data of civil society, while political arithmetic was characterized as the application of mathematical analysis to such subjects as population and related matters of interest to the public economy.[20] The purposes and ends upon which the concept of political arithmetic had originally been premissed were now in large measure outmoded, but fundamental political, economic, and social upheavals, notably the French Revolution and the Industrial Revolution, were thrusting forward new needs, problems, and goals to be handled by statistical means.

The transitional character of this period is evident also in the condition of its statistical knowledge and techniques. By the end of the eighteenth century, vital statistics were more widely available than they had been in 1700. To be sure, these data were imperfect in many respects. Nevertheless, there was already considerable insight into the nature of statistical materials, and it was recognized that more and better observations were needed. Similarly, while elementary statistical methods were being

[18] E. E. Duvillard: *Analyse et tableaux de l'influence de la petite vérole sur la mortalité à chaque âge*, Paris, 1806.

[19] Gottfried Achenwall: *Abriss der neuesten Staatswissenschaft der Vornehmsten Europäischen Reiche und Republicken*, Göttingen, 1749, p. 1.

[20] Institut Royal de France. Académie Royale des Sciences: *Programme du prix de statistique proposé par l'Académie Royale des Sciences pour l'année 1818*, Paris, 1817, pp. 2-3.

practised, it was necessary also to improve and to develop such techniques, particularly tests by which the validity of conclusions drawn from statistical material could be checked. In short, the problems which characterize this transitional period are (1) to define more precisely what was already known, (2) to increase existing statistical knowledge through sound methods, and (3) to develop the proper tools for handling and analyzing statistical observations.

An important question involved in these problems is to determine the reliability of conclusions from numerical observations. The question had already been raised by various scientists, and Laplace's contribution in applying probability theory to the determination of population has been mentioned. As yet there was no close contact between the calculus of probability and the statistical investigation of health questions. However, the importance of bridging the gap between these areas was recognized by Condorcet, the Encyclopedist and revolutionary, who spent the last months of his life in projecting a history of the progress of the human mind. In this paean to the unlimited perfectibility of man, he prophesied that preventive medicine would eventually lead to the disappearance not only of communicable diseases, but also of those due to nutrition, occupation, and climate. Condorcet conjectured that the calculus of probability would be a powerful instrument in this advance.[21]

Condorcet's work appeared posthumously in 1795. Twelve years later, in 1807, his friend Philippe Pinel presented a report to the *Institut National* in which he undertook to prove statistically the value of his "moral treatment" of patients at the Salpêtrière.[22] It seems likely that Pinel was influenced by Condorcet. This may, perhaps, be seen in his emphasis on the need to use the calculus of probability to establish whether results obtained in treating patients were simply a matter of chance, or whether they were actually a result of the therapy employed. Pinel also stressed the need for accurate records on each patient, records that would contain all the information relevant to the case. If such records were kept continuously over a period of many years he pointed out, it would be possible to establish the advantages or disadvantages of various forms of therapy, to determine how many patients were benefited and could be released as cured, how many relapsed, as well as other types

[21] Condorcet: *Tableau historique des progrès de l'esprit humain*, Paris, 1900, pp. 147-150.

[22] Pinel: Resultats d'observations et construction des tables pour servir à déterminer le degré de probabilité de la guérison des aliénés, *Mémoires de la classe des sciences mathématiques et physiques de l'Institut National de France*, Premier semestre de 1807, Paris, 1807, pp. 169-205

of important information. Furthermore, were several hospitals to follow this procedure, comparisons might be instituted among them. Obviously the conditions for a statistical study of this kind did not exist in Pinel's day; indeed even in our time they have not been fully achieved. What Pinel did was to summarize his records on 1002 patients whom he had treated over a five-year period, from 1801 to 1805. He prepared the data in tabular form, but did not subject the figures to any analysis beyond establishing certain simple ratios, for example, the ratio between the number of admissions and the number of cures in different diagnostic categories (mania, melancholia, dementia, idiocy), and certain specific numerical facts, as for instance the number of patients admitted without a history, the number of deaths, and the like.

Pinel's memoir appears to have impressed his contemporaries. Cuvier mentions it in the report on the progress of the natural sciences since 1789 which he presented to Napoleon in 1808.[23] Stating that "a felicitous means of establishing the general results of various trials" was being used more frequently to check the results of medical experience, he described this method as the use of "comparative tables which present at a glance the complete picture of an epidemic, or the extended results of the practice of a hospital." In Cuvier's opinion, "M. Pinel has given an interesting example relating to mental illnesses, showing the greater or lesser probability of curing each kind." Cuvier goes on to comment that of all the uses made of such tables until then, none was as satisfying as that which demonstrated the value of smallpox vaccination by means of a comparison with the ravages of the disease. This opinion is supported by a reference to Duvillard's work previously mentioned.[24]

Despite the best intentions, however, the use of probability theory in the study of health problems made no headway at this time. Nevertheless, there was a continuing interest in a numerical approach to questions of health and disease. Fed by various sources, this interest provided a fruitful basis for the development of a new period in the late 'twenties of the nineteenth century. Medical, socio-economic, and theoretical trends and influences were involved in this process. For one thing, the question of certainty in medicine was a matter of considerable moment at the time.[25]

[23] *Rapport historique sur les progrès des sciences naturelles depuis 1789, et sur leur état actuel . . .* rédigé par M. Cuvier, Paris, 1810, pp. 348-349.

[24] See footnote 18.

[25] P. J. G. Cabanis: *Du degré de certitude de la médecine*, Paris, An VI, 1798; B. J. Feijóo: *Teatro Critico Universal* (Clásicos Castellanos), Madrid, 1941, vol. I, pp. 107-162; F. P. Gay: Medical Logic, *Bull. Hist. Med.*, 7:6-27, 1939; J. B. Bouillaud: *Essai de philosophie médicale*, Paris, 1836.

Confronted by a variety of conflicting schools and doctrines (vitalists, empiricists, Brunonians, Hippocratics, humoralists), how was the practitioner to determine the true from the false? Furthermore, related to this question was the problem of establishing inhowfar the course of a disease was due to the power of nature or to the art of the physician. Faced by these dilemmas, physicians turned to mathematical analysis as a possible tool for solving such problems.[26] This trend was particularly marked in France where medicine was strongly influenced by the philosophy of ideology derived from the teachings of Condillac. Had not Condillac said that the tongue of science is calculation?[27] In addition, the effect exerted by the development of mathematics under the influence of the French Revolution cannot be overlooked. Problems of epidemic disease and public health also provided an important stimulus to a continuing interest in the numerical method. As the industrial system developed and spread, its effects on the mass of the people aroused increasing concern. This interest in the social problem created by industrialization was an important motivating element in fostering the statistical analysis of health questions. It had been recognized much earlier that health conditions were in many ways causally related to the socio-economic environment. The problem now became that of explicitly connecting poor health with deleterious social conditions on the basis of numerical data.[28]

Around 1830, studies of health problems based on numerical data began to appear in increasing numbers. Concerned with questions of public health and clinical medicine, these investigations soon attracted wide professional and public attention. The decades from 1830 to 1860 represent the flood tide of such studies on the continent of Europe, in Great Britain, and in the United States. In addition to the influences previously mentioned, there were other conditions favorable to this development, particularly in England and France. Between 1801 and 1831, four general censuses were carried out in England, and perhaps even more important, civil registration of vital statistics was established in 1837. Even prior to the passage of the Registration Act, its significance for the statistical study of health problems had been apparent to men like Edwin Chadwick and William Farr.[29] Under the latter's direction, the quality of the

[26] E. Chauffard: *Andral, la médecine française de 1820 à 1830,* Paris, 1877, p. 42.

[27] E. de Condillac: *La langue des calculs. Ouvrage posthume et élémentaire,* 2 vols., Paris, An VII, 1799.

[28] For example, see F. Bisset Hawkins: *Elements of Medical Statistics,* London, 1829, pp. 1-3.

[29] Edwin Chadwick: *The Health of Nations. A Review of the Works of Edwin Chadwick. With a Biographical Dissertation, by Benjamin Ward Richardson,* London, 1887, 2

enumerated data was improved and a solid basis for statistical analysis was created. While France lagged behind England in this respect, the French gave considerable impetus to the statistical study of clinical problems. Pinel's endeavor in this direction has been mentioned. Similar ideas appeared elsewhere. At Bologna in 1821, Giacomo Tommasini emphasized the necessity of applying statistics to medical practice; and in 1829 the *Elements of Medical Statistics* by F. Bisset Hawkins appeared, the first English book concerned exclusively with the subject.[30] However, the employment of statistics in clinical problems assumes a sound nosography, and in this area the French school of the early nineteenth century was preeminent, having developed a solid basis of knowledge derived from clinical-pathological studies. Furthermore, in both countries, journals were started which made possible the publication of statistical studies. In 1829, the *Annales d'hygiène publique* began to appear, and the *Journal of the Statistical Society of London* started publication in 1838.

The period from 1830 to 1850 was a seed-time of history, the opening of a new era, that in which we still find ourselves. Like all such phases it was marked by exaltations and enthusiasms, and it is no surprise to find these characteristics evident in the history of statistics.[31] Westergaard very aptly characterized this period as an era of enthusiasm.[32] With great zeal numerous investigations undertook to examine the problem of health under a wide variety of circumstances. Some were undertaken in the course of official inquiries, others by private citizens whose interest was attracted to a specific social problem. Many were concerned with the question of differential mortality and the effect on health of such factors as economic and social class, occupation, race, imprisonment, intemperance, or lack of proper sanitation. It is patently impossible to list and to discuss all such studies here. For our purpose a few representative examples will suffice.

In France, Parent-Duchatelet and D'Arcet studied the effect of tobacco on the health of workers handling it.[33] Benoiston de Chateauneuf ex-

vols., vol. I, pp. XLIII-XLVI, 77-78; William Farr: Vital Statistics; or the Statistics of Health, Sickness, Disease and Death, in McCulloch's *Statistical Account of the British Empire*, vol. 2, 1837, pp. 567-601.

[30] Giacomo Tommasini: *Della necessità di sottoporre ad una statistica i fatti più importanti della medicina pratica*, Bologna, 1821; Antonio Cazzaniga: *La grande crisi della medicina italiana nel primo ottocento*, Milan, 1951, pp. 75-89; see above footnote 28.

[31] D. O. Evans: *Social Romanticism in France 1830-1848*, Oxford, 1951; Francis Fejtö, editor; *The Opening of an Era, 1848. An Historical Symposium*, London, 1948.

[32] Westergaard, *op. cit.*, p. 136.

[33] Parent-Duchatelet and D'Arcet: Mémoire sur les véritables influences que le tabac

amined the differential mortality of rich and poor.[34] Villermé investigated the health of textile workers; differential mortality in various districts of Paris; and the mean duration of illness at different ages so as to apply this knowledge to the organization of mutual aid societies.[35]

Among English contributors William Farr and William A. Guy may be mentioned. The former needs no introduction. Throughout his long and fruitful career, Farr made numerous contributions to the statistical study of health problems. Particular attention may perhaps be called to his numerous studies of occupational mortality.[36] While Guy cannot be considered on the same level as Farr, he deserves to be better known. Professor of forensic medicine at the University of London, he was also an indefatigable student of statistical problems, a frequent contributor to the *Journal of the Statistical Society of London*, and an active participant in the public health movement.[37] Guy was especially interested in the influence of occupation on health, and he studied bakers, scavengers, printers, tailors, and many other groups of workers. In addition, he examined the causes leading to the choice of an occupation, the effects of season and weather on mortality, and the duration of life among the gentry, the aristocracy, the clergy, and the professions.[38] Studies similar

peut avoir sur la santé des ouvriers occupés aux différentes préparations qu'on lui fait subir, *Ann. d'Hyg. Publ.* 1: 169-227, 1829.

[34] Benoiston de Chateauneuf: De la durée de la vie chez le riche et chez le pauvre, *Ann. d'Hyg. Publ.* 3: 5-15, 1830.

[35] Villermé: De la santé des ouvriers employés dans les fabriques de soie, de coton et de laine, *Ann. d'Hyg. Publ.* 21: 338-420, 1839; Sur la durée moyenne des maladies aux différens âges et sur l'application de la loi de cette durée et de la loi de la mortalité à l'organisation des sociétés de secours mutuels, *Ann. d'Hyg. Publ.*, 2: 241-266, 1829; De la mortalité dans les divers quartiers de la ville de Paris, et des causes qui la rendent très différente dans plusieurs d'entre eux, ainsi que dans les divers quartiers de beaucoup de grandes villes, *Ann. d'Hyg. Publ.* 3: 294-339, 1830.

[36] William Farr: *Vital Statistics: A Memorial Volume of Selections from the Reports and Writings*, edited by Noel A. Humphreys, London, 1885, pp. 392-411.

[37] For the biography of Guy see the *Dictionary of National Biography*. As an example of his activities see William A. Guy: *The Case of the Journeymen Bakers: Being a Lecture on the Evils of Night-Work and Long Hours of Labour, Delivered on Thursday, July 6, 1848 at the Mechanics Institution, Southampton Buildings*, London, 1848.

[38] W. A. Guy: An Attempt to determine the Influence of the Seasons and Weather on Sickness and Mortality. *Journal of the Statistical Society of London* 6: 133-150, 1843; Contributions to a Knowledge of the Influence of Employments upon Health, *ibid.* 6: 197-211, 1843; Further Contributions to a Knowledge of the Influence of Employments upon Health, *ibid.* 6: 283-304, 1843; A Third Contribution to a Knowledge of the Influence of Employments upon Health, *ibid.* 7: 232-243, 1844; On the Causes Which Determine the Choice of an Employment; Being an Addition to the Essays on the Influence of Employments upon Health, *ibid.* 8: 351-353, 1845; On the Duration of Life in the Members of the Several Professions, *ibid.* 9: 346-354, 1846.

to those carried on in England and France are to be found during this period in various European countries and the United States. Lemuel Shattuck's *Sanitary Report* of 1850 was clearly influenced by French and English investigations of health problems.

These studies in the field of public health were paralleled by efforts to apply statistical analysis to clinical problems. The key figure in this development was the physician P. C. A. Louis, who advocated and employed that he called the *numerical method*. What Louis did was to study each patient as thoroughly as possible at the bedside and at autopsy, that is, he employed rigorously the methodology already established by Bayle, Laennec, and others of the Paris School. Having carefully collected his observations, he then grouped them in tabular form. From these groupings, inferences might be drawn concerning the value of a given therapy, or the relations between clinical phenomena. Although adumbrated in his earlier publications on phthisis (1825) and typhoid fever (1829), the numerical method was first fully presented in 1835 in his therapeutic study *Recherches sur les effets de la saignée*.

Essentially, the numerical method of Louis was not new. The procedure had been followed some three decades earlier by Pinel, and was being employed in the 'twenties and 'thirties by physicians dealing with public health problems. According to his biographer, Parent-Duchatelet always recorded and numbered his observations. " The words *often, sometimes*, never entered his notes. He required figures, exact figures, collected one by one and capable of being used as mutual controls. Nothing equalled the rigorousness of his method." [39] Furthermore, there is nothing new in Louis' handling of numerical data. It is said that Louis was familiar with the work of Laplace on probability, but there is no evidence that such knowledge ever entered into his statistical thinking.[40] Like so many of his contemporaries he dealt with small numbers of observations, and had no knowledge of how to establish the precision or validity of his results.

Nevertheless, Louis has an important place in our story. First of all, he did recognize the importance of having accurate observations. His insistence on good clinical records established a fundamental principle for statistical work in clinical medicine. Secondly, Louis made an important contribution as a teacher and a propagandist. Through his students, through the *Société médicale d'observation* which several of them founded

[39] Fr. Leuret: Notice sur A.-J.-B. Parent-Duchatelet, in, A.-J. B. Parent-Duchatelet: *De la prostitution dans la ville de Paris*, 3rd edition, 2 vols., Paris, 1837, vol. 1, p. XIII.
[40] R. H. Shryock: *The Development of Modern Medicine*, New York, 1947, p. 158.

in 1832, and by his writings, Louis spread the idea of the numerical method against vigorous opposition.

Certain defects are common to all the studies of this period, whether in public health or clinical medicine. Many studies were carried out on institutional populations, for example, patients in hospitals, asylum inmates, prisoners. As a result the samples with which they dealt were in most cases too small or not representative. Despite these shortcomings, there is evidence that the question of precision in statistical results was attracting increasing attention.[41] For the most part, however, the question was handled by rule of thumb. One aspect of the problem was to decide when the number of observations was large enough to avoid error. Different authors employed different practical rules. Thus, in his study of the health of textile workers, Villermé calculated the probable duration of life only where more than 100 deaths had been observed. According to Guy no general rule can be given as to the number of observations. But, he says

> where our means or instruments of observation are imperfect, or the things observed differ widely in numerical value, a large number of observations is necessary, in other cases a smaller number can suffice. Perhaps the best rule which can be given for ascertaining whether the observations which we have collected are sufficiently numerous to yield a true average, is to divide the whole number of observations into groups of equal size and compare them, the one with the other: if the average value of each group is the same, we may safely conclude that we have arrived at the true mean; if not, we must increase the number of our observations, and the size of our groups, till the desired equality is obtained.[42]

While medical statisticians were still groping for solutions to the problem of precision, mathematicians had developed tools for dealing with it. Laplace's *Théorie analytique des probabilités* had appeared in 1812. In this work he had called attention to the significance of probability theory for medical investigations, but had not pursued the matter further. In 1837, Poisson published his important *Recherches sur la probabilités des jugements* in which he showed how to calculate the mean error of a difference between two observed frequencies, an operation which is directly applicable to medical statistics. Three years later, Jules Gavarret, a student of Poisson, published his *Principes généraux de statistique médicale* in which he applied Poisson's work. Despite its merits, however, Gavarret's treatise did not receive the attention it deserved. Ten years

[41] J. Bouillaud: *Essai sur la philosophie médicale . . .*, Paris, 1826, pp. 96-97, 185-201.

[42] W. A. Guy: On the Value of the Numerical Method as applied to Science, but especially to Physiology and Medicine, *Journal of the Statistical Society of London*, 2: 33, 1839.

later, for example, Guy still expressed the opinion that "the formulae of the mathematician have a very limited application to the results of observation; and that if incautiously applied, they may lead to very great errors."

This pattern of uneven advance, of hesitating and uncertain development was not peculiar to the health field. It is one aspect of a general phenomenon which characterizes the state of development of various biological and social sciences toward the middle of the nineteenth century. Schumpeter in his recently published *History of Economic Analysis* gives a similar picture of the relations during this period between economics and statistical analysis.[43] Yet it was at this time that the first major step was successfully taken to bring mathematical analysis to bear on the data compiled by observation and enumeration. This was the achievement of Adolphe Quetelet, Belgian mathematician and astronomer.[44]

What did Quetelet do? He gathered together the statistical tendencies and developments of his time, built them into a systematic structure in terms of a guiding theoretical concept, and undertook to show how it could be applied in practice. Quetelet recognized that variation is a characteristic of all biological and social phenomena, and that such variation occurred around the mean of a number of observations. Based on this recognition, Quetelet developed a methodology which comprised the determination of statistical averages, the establishment of the limits of variation around an average, and investigation of the conditions under which variation would occur. Furthermore, he showed that the distribution of observations around a mean corresponded to the distribution of probabilities on a probability curve. The theoretical expression of this methodology was Quetelet's concept of the *average man* (*l'homme moyen*). The germ of his contribution is to be found in his work *Sur l'homme* which appeared in 1835, and was fully developed in the book *Du système social* published in 1848.[45]

Quetelet was peculiarly well suited to make his important contribution. During a visit of several months at Paris in 1823-24, he had come into close contact with French mathematicians interested in the theory of probability, among them Laplace, Fourier, and Poisson. Later he also

[43] J. A. Schumpeter: *History of Economic Analysis*, New York, 1954, pp. 524-536.

[44] For biographical data on Quetelet see Frank H. Hankins: *Adolphe Quetelet as a Statistician*, New York, 1908.

[45] A. Quetelet: *Sur l'homme et le development de ses facultés, ou essai de physique sociale*, 2 vols., Paris, 1835; idem: *Du système social et des lois qui le régissent*, Paris, 1848; M. Halbwachs: *La théorie de l'homme moyen, Essai sur Quetelet et la statistique morale*, Paris, 1913.

entered into friendly relations with French physicians concerned with the statistical study of health problems, of whom the most important were Villermé and Benoiston de Chateauneuf.[46] Through these contacts and influences, and because of his connection with the handling of official statistics, Quetelet had an abundance of data at his disposal. Also, as an active organizer of and participant in numerous statistical congresses, he was able to spread his ideas and work widely. Finally, because he stated the results of his mathematical analysis clearly and lucidly, Quetelet was able to reach a large public with his writings. His numerous publications thus facilitated a general appreciation and adoption of his ideas.

The statistical treatment of health problems continued into the second half of the nineteenth century along the lines of development sketched in the preceding discussion. Improvements were made in the technique of statistical observation, and concrete statistical materials continued to be accumulated. But there were no further basic contributions to statistical theory and methods of analysis until the last quarter of the nineteenth century when Francis Galton and Karl Pearson began to attack the problems of correlated variations and the asymmetry of frequency distributions, thus opening up the most recent period in the statistical analysis of health problems. These developments were possible, however, because a firm foundation had been laid. The elements of this foundation were the coordination of the different departments of scientific knowledge necessary for statistical analysis, and the creation of methods and organizations for the collection of observations relating to health. In retrospect, it is clear that this was the fundamental problem in applying statistical analysis to health problems.

[46] E. H. Ackerknecht: Villermé and Quetelet, *Bull. Hist. Med.*, 26: 317-329, 1952.

THE EARLY HISTORY OF VITAL STATISTICS IN MASSACHUSETTS *

JOHN B. BLAKE

Nearly two centuries before the mother country, the General Court of Massachusetts established civil registration of vital statistics, ordering on September 9, 1639, that a record be kept of every marriage, birth, and death.[1] But the law, though amended from time to time,[2] was rarely enforced. For some towns excellent records exist today, but in others they are obviously incomplete, and they tended to become poorer with time. In Boston, for example, a few pages sufficed for all the births and deaths registered from the middle of the eighteenth century until 1810.[3] Moreover, while historians can profitably study some of these records,

* Read at the twenty-seventh annual meeting of the American Association of the History of Medicine, New Haven, Connecticut, May 6, 1954. The grant of a James Hudson Brown Memorial Research Fellowship by the Yale University School of Medicine made possible the preparation of this paper.

[1] Massachusetts General Court, *Records of the Governor and Company of the Massachusetts Bay in New England, 1628-86* (Nathaniel B. Shurtleff, ed., Boston, 1853-54), I, 276. Not until 1837 did England establish registration as a civil rather than an ecclesiastical function (R. A. Lewis, *Edwin Chadwick and the Public Health Movement 1832-1854* [London, 1952], 30-31). The Church of England had long been recording baptisms and burials (rather than births and deaths) when the colonies were settled, and many Massachusetts churches also kept similar records. Virginia provided by law for ecclesiastical registration in 1631 (Henry D. Holton, "Development of Vital Statistics," American Statistical Association, *Publications*, X [1906-07], 480), and Connecticut for civil in 1644 (Ira V. Hiscock, "The Background of Public Health in Connecticut," Herbert Thoms, ed., *The Heritage of Connecticut Medicine* [New Haven, 1942], 137).

[2] Mass. General Court, *Records of the Governor and Company*, II, 15; III, 426-427; idem, *The Laws and Liberties of Massachusetts; Reprinted from the Copy of the 1648 Edition in the Henry E. Huntington Library* (Cambridge, 1929), 46-47; idem, *The Colonial Laws of Massachusetts. Reprinted from the Edition of 1660 . . .* (William H. Whitmore, ed., Boston, 1889), 188; idem, *The Colonial Laws of Massachusetts. Reprinted from the Edition of 1672 . . .* (William H. Whitmore, ed., Boston, 1890), 130; 1692-93, ch. 48, idem, *The Acts and Resolves, Public and Private, of the Province of the Massachusetts Bay* (Boston, 1869-1922), I, 104-105. See Robert R. Kuczynski, "The Registration Laws in the Colonies of Massachusetts Bay and New Plymouth," American Statistical Association, *Publications*, VII (1900-01), 65-73.

[3] Lemuel Shattuck, *The Vital Statistics of Boston; Containing an Abstract of the Bills of Mortality for the Last Twenty-Nine Years, and a General View of the Population and Health of the City at Other Periods of Its History* (Philadelphia, 1841, extracted from *The American Journal of the Medical Sciences*, n. s. I [1841], 369-401, and reprinted in Boston Registry Department, *Bills of Mortality, 1810-1849, City of Boston* [Boston, 1893], ix-xliii), xi-xii.

nearly all of which have now been published, they were not used nor intended to be used during the colonial period for public health or other medical purposes.

Other means of gathering vital statistics were, however, available. During a frightful smallpox epidemic in 1678, Cotton Mather wrote that "To attempt a Bill of Mortality, and number the very spires of grass in a Burying Place seem to have a parity of difficulty and in accomplishment."[4] But after the epidemic of 1721 was nearly over, the selectmen of Boston took a census to discover the number of persons who had had the disease and the number of deaths during each month of its prevalence. Combined with Zabdiel Boylston's account of the results of smallpox inoculation, the figures offered, or seemed to offer, an impressive demonstration of the value of this new procedure. Though the local authorities failed to obtain similar statistics of the outbreak in 1730, after each of the five subsequent epidemics they queried every family to find out the number of cases and deaths of both the inoculated and the natural varieties of the disease.[5]

In other respects the records of this period are less impressive. From 1704 until 1775 local newspapers published the number of burials, but the fact that the deaths were not differentiated by cause, age, or sex—though they were by race—indicates how little interest existed in employing the data for the study of disease. Moreover, the Revolution interrupted even these sparse figures, and the attempt of a Boston newspaper to revive them during the 1780's failed.[6]

[4] Cotton Mather to John Cotton, Nov. 1678, in Massachusetts Historical Society, *Collections*, ser. 4, VIII (1868), 383-384.

[5] John B. Blake, "The Inoculation Controversy in Boston: 1721-1722," *The New England Quarterly*, XXV (1952), 489-506; idem, "Smallpox Inoculation in Colonial Boston," *Journal of the History of Medicine and Allied Sciences*, VIII (1953), 284-300.

[6] "Account of Burials and Baptisms in Boston, from the Year 1701 to 1774," Mass. Hist. Soc., *Collections*, ser. 1, IV (1795), 213-216; Shattuck, *Vital Statistics of Boston*, xii; idem, *Report to the Committee of the City Council Appointed to Obtain the Census of Boston for the Year 1845* . . . (Boston, 1846), Appendix, 71-72; *Massachusetts Centinel*, Mar. 31, June 5, Aug. 4, Sept. 1, Oct. 2, Nov. 3, Dec. 1, 1784; Jan. 1, Feb. 1, Mar. 2, 1785; Jan. 4, 1786. See also, Josiah H. Benton, Jr., *Early Census Making in Massachusetts 1643-1765 with a Reproduction of the Lost Census of 1765 (Recently Found) and Documents Relating Thereto* (Boston, 1905). William Douglass made some epidemiological use of these figures: see *The Practical History of a New Epidemical Eruptive Miliary Fever* . . . (Boston, 1736), 2-3, 16. For an excellent example of modern use of colonial mortality records, see Ernest Caulfield, "A History of the Terrible Epidemic, Vulgarly Called the Throat Distemper, as It Occurred in His Majesty's New England Colonies between 1735 and 1740," *Yale Journal of Biology and Medicine*, XI (1938-39), 219-272, 277-335.

Within a few years, however, interest in vital statistics expanded remarkably. While this was no doubt due in part to the influence of developments in other countries, several local factors also fostered the trend. As a period of social no less than political upheaval, the Revolutionary era stimulated humanitarian concern for the public health. Following Philadelphia's example, Harvard founded a medical school in 1783.[7] The American Academy of Arts and Sciences was chartered in 1780, among other purposes, "to promote and encourage medical discoveries." Counting several physicians among its original incorporators, the Academy in its early years received many communications of a medical nature and printed some in its *Memoirs*.[8] Of more direct consequence to local practitioners was the Boston Medical Society, which became the nucleus of the Massachusetts Medical Society, chartered in 1781.[9]

One purpose of this new organization was to examine and license physicians so the public might know which were worthy of confidence; another, to advance medical science. With the latter aim in mind Dr. Edward Augustus Holyoke, submitting a bill of mortality for Salem in 1786, called upon others to contribute similar records, so that "a history of those diseases which are either epidemical or endemical in our country" might be compiled. "Indeed," he urged, "the joint efforts of many engaged in the same design, may accomplish, in a few years, what would be impracticable to a few individuals, though employed for ages."[10]

In November 1785 the Academy of Arts and Sciences similarly solicited ministers and physicans throughout the state to return "regular and uniform Bills of Mortality." Thereby, the Academy pointed out, "the rate of our population may be determined; the present value of estates, holden for life, or in reversion, ascertained; and a natural history of the diseases incident to our climate, compiled." Providing a sample blank form, the Academy asked for the number of living by sex and five-year age groups, and the number of births, marriages, families, houses, emi-

[7] Thomas F. Harrington, *The Harvard Medical School, a History, Narrative and Documentary* (New York, 1905), I, 77-87.

[8] 1779-80, ch. 46, sec. 7, Mass. General Court, *Acts and Resolves, Public and Private, of the Province of the Massachusetts Bay*, V, 1196; American Academy of Arts and Sciences, *Memoirs*, I (1785), 529-568; II, part 1 (1793), 186-200; II, part 2 (1804), 130-139; Walter L. Burrage, *A History of the Massachusetts Medical Society . . .* (Norwood, 1923), 14-15.

[9] Edward Warren, *The Life of John Warren, M. D.* (Boston, 1874), 222-223; Burrage, *History of Mass. Med. Soc.*, 15-19.

[10] Edward A. Holyoke, "An Account of the Weather and of the Epidemics, at Salem, in the County of Essex, for the Year 1786," Massachusetts Medical Society, *Medical Communications*, I, no. 1 (1790), 18-19.

grants, and immigrants. It specified the names of the diseases under which deaths were to be recorded, and called for the number of deaths from each disease by age and by month.[11] The amount and character of information requested in this plan represented a substantial advance over existing bills of mortality; indeed, it provided for data which were not compiled in Boston until 1850.

Though the Academy probably received few returns made out in all the desired detail, many persons—most of them ministers rather than physicians—submitted bills of mortality of some description.[12] Touring the United States in 1788, Jacques Pierre Brissot de Warville noted how difficult it was to secure tables of longevity, which, he wrote, "may be every where considered as the touchstone of governments; the scale on which may be measured their excellencies and their defects, the perfection or degradation of the human species." But he found excellent records for some New England towns, and presenting life tables compiled by Professor Edward Wigglesworth for Harvard graduates, for Hingham, Massachusetts, and for Dover, New Hampshire, Brissot expressed a hope that similar figures would soon be available for all the states.[13] Though this desire was unfulfilled, Wigglesworth in 1792 submitted to the Academy a life table for Massachusetts and New Hampshire based on the bills of mortality in its files. Despite its faults, the table was, except for the attempt to evaluate smallpox inoculation, the first significant American contribution to vital statistics. Sixty years later the Wigglesworth tables, having been adopted by the state Supreme Court, were still in general use in Massachusetts.[14]

[11] American Academy of Arts and Sciences, broadside, dated Nov. 10, 1785 (Worthington C. Ford, *Broadsides, Ballads, &c. Printed in Massachusetts 1639-1800* [Mass. Hist. Soc., *Collections*, LXXV, 1922], no. 2401).

[12] *Massachusetts Centinel*, Apr. 17, 1787; Sept. 3, 1788; Feb. 7, June 13, Aug. 29, 1789; Feb. 6, June 9, 1790; *Columbian Centinel*, July 2, Nov. 12, 1791; Mar. 3, 1792; June 8, 1793; June 7, 1794, June 4, 1796; Feb. 8, 1797; Feb. 3, 1798; Feb. 27, 1799.

[13] Jacques Pierre Brissot de Warville, *New Travels in the United States of America, Performed in M. DCC. LXXXVIII.* (2nd ed., London, 1794), I, 304-309.

[14] Edward Wigglesworth, "A Table Shewing the Probability of the Duration, the Decrement, and the Expectation of Life, in the States of Massachusetts and New-Hampshire, Formed from Sixty Two Bills of Mortality on the Files of the American Academy of Arts and Sciences, in the Year 1789," American Academy of Arts and Sciences, *Memoirs*, II, part 1 (1793), 131-135; *Columbian Centinel*, Mar. 3, 1792; Massachusetts, Secretary of the Commonwealth, *Tenth Report to the Legislature of Massachusetts, Relating to the Registry and Returns of Births, Marriages, and Deaths, in the Commonwealth, for the Year Ending December 31, 1851* (Boston, 1852), 71. See also, Edward A. Holyoke, "On Meteorological Observations and Bills of Mortality," American Academy of Arts and Sciences, *Memoirs*, II, part 2 (1804), 58-61; Joseph M'Kean, "Synopsis of

Other unofficial agents were less successful. In July 1804 the editor of a Boston literary magazine, *The Monthly Anthology,* persuaded some of the local physicians to supply statistics of births and deaths. He soon complained, however, that some practitioners were reporting diseases unknown to nosologists, and after a few months he was forced to give up printing the figures. Although in his opinion "a regard to the science, the history, and the honour of our country" demanded the publication of these data, the physicians apparently disagreed.[15]

Despite this failure, the editor of *The Medical and Agricultural Register,* Dr. Daniel Adams, in 1806 proposed a more ambitious plan, a bill of mortality for the whole state. To ascertain "more effectually the prevalent diseases, their probable causes, mortality, connexion with the seasons, and the comparative healthiness of the several towns in this commonwealth," he requested the clergy to record information on deaths, the rise and fall of epidemics, "assignable causes, if any may be known, as stagnated waters, uncleanliness, sources of putrefaction, modes of living, &c.," weather conditions, and any other observations they might think important. What was impossible for one or a few, he concluded, would be easy for all.[16]

In support of the project, the Reverend Ebenezer Hill of Mason, New Hampshire, wrote of his belief that "an accurate record of deaths and diseases, kept in the several towns in a country, published annually, and collected and preserved in some public register, would not only form a history of the progress and decline of diseases, but might greatly assist in the improvement of the medical art." Ministers were in a favorable position to keep such records, he argued, and "as far as this may have even a remote tendency to alleviate the miseries of their fellow creatures, it cannot be considered an object unworthy their attention."[17] Hill included a topographical description of his home town and a bill of mortality for 1798-1805, but when others contributed similar papers, the editor soon discovered that many readers found them tedious. Though he still hoped for the necessary data for an annual bill of mortality for the

Several Bills of Mortality," *ibid.*, 62-66; idem, "Deductions from Select Bills of Mortality," *ibid.*, 66-70.

[15] *The Monthly Anthology, and Boston Review,* I (1803-04), 429, 574 n; II (1805), 221.

[16] "To Gentlemen of the Clergy," *The Medical and Agricultural Register,* I (1806-07), 16.

[17] Ebenezer Hill, "Observations on the Importance of Accurate Records Being Kept of the Diseases and Deaths in Every Town . . . ," *ibid.*, 12-14.

state, in the event he was able to present the figures for only twenty towns.[18]

By then a few local governments were beginning to take up the task, which magazine editors and clergymen, however commendable their motives, were unable to carry out. During a yellow fever scare in Boston in 1796, a local newspaper averred that "there has scarcely been a summer in our remembrance when so few deaths occurred."[19] But two years later, when yellow fever again attacked Boston, such off-hand assurances proved insufficient, and the selectmen were eventually constrained to publish the specific number of cases and deaths, obtained, after some prodding, from the physicians. At least one Bostonian allowed that the figures had frightened him until he calculated—"To have a clear idea of any thing," he wrote, "it is necessary to submit it to calculation"—that at the peak of the epidemic Boston's death rate was no higher than London's ordinarily.[20] For a few months in 1805 and again in 1806, hoping to forestall false rumors of sickness, the Boston Board of Health published weekly bills of mortality.[21] Finally, in 1810, in order to obviate the imputed danger of infection from Boston's crowded cemeteries, the General Court empowered the Board to regulate burials. The health officials seized this opportunity to require the burial ground superintendents to report weekly the name, age, sex, and cause of death of each person interred.[22] After gathering a full year's data, the Board compiled an abstract for publication. The same procedure was followed in subsequent years, and the bills of

[18] "Bills of Mortality," *ibid.*, 188; "To Gentlemen of the Clergy," *ibid.*, 208; "Bills of Mortality," *ibid.*, 240; "Bill of Mortality for 1806, in 20 Towns," *ibid.*, 284-285. The editor hoped for better results the following year, but the journal ceased publication before the returns were in.

[19] *Columbian Centinel*, Aug. 27, 1796. See also, Boston Record Commissioners, *Report* (Boston, 1876-98), XXVII, 296-297.

[20] *Ibid.*, 335-345; *Columbian Centinel*, Aug. 4-Oct. 13, 1798. The quotation is from the issue of Sept. 26.

[21] Boston Board of Health, Records (1799-1806), 289, MS. in Boston Public Library; Boston Registry Department, *Records Relating to the Early History of Boston* (Boston, 1900-09), XXXIII, 308; *Columbian Centinel*, July 24, 1805-Mar. 22, 1806; Aug. 16-Nov. 15, 1806. The Board arrested two men in August 1805 for falsely and maliciously declaring that yellow fever and smallpox raged in Boston. *Ibid.*, Aug. 17, 21, 1805.

[22] Board of Health, Records (1806-10), Feb. 13, Mar. 12, 19, May 7, Aug. 1, 2, 3, Oct. 11, 1810; Registry Dept., *Records*, XXXIII, 201-202, 425, 428, 442; XXXV, 257-260, 276-277; Board of Health, *Rules and Regulations for the Police of the Burying Grounds . . .* (Broadside, Boston, 1810); Mass. *Laws*, 1809, ch. 124 [125]. (The act is listed in Mass. General Court, *Laws of the Commonwealth of Massachusetts*, V [Boston, 1809-12], 221-222, as ch. 124; and in idem, *The General Laws of Massachusetts, from the Adoption of the Constitution, to February, 1822* [Asahel Stearns and Lemuel Shaw, comrs., Theron Metcalf, ed., Boston, 1823], II, 259, as ch. 125.)

mortality were printed on broadsides and in local newspapers and medical journals.[23]

Simple in arrangement, the bills tabulated the number of deaths each month by sex and age and listed separately the number of persons of all ages who had died throughout the year from each of various named causes. Unfortunately the nomenclature, as well as the form, was highly unsatisfactory. The inadequacies of contemporary medical science made this to a large degree inevitable, but in addition physicians were not required to report causes of deaths. Several times during the 1820's the superintendent of burials sought the assistance of the members of the profession; he even addressed a printed card to each one containing simple and precise directions for making out returns. But they paid little attention to his requests.[24] Many "causes," therefore, were merely those which the undertaker could obtain from the family; many are meaningless now.

In 1826, however, Dr. Walter Channing, who was during his lifetime involved in many humanitarian endeavors, inaugurated a campaign to improve the city's death registration. "Notwithstanding the existing regulations," he wrote, "very little useful information is obtained from our bills of mortality." With accurate data, he argued, physicians could investigate the causes of many diseases, the rise and fall of epidemics, and the means of guarding against them, as well as the comparative healthiness of different places, seasons, and occupations. He proposed that undertakers be required to obtain death certificates from physicians and that the profession adopt a standard nosology.[25]

Before long others were supporting these recommendations.[26] In addi-

[23] Board of Health, Records (1810-16), Dec. 30, 1811; Jan. 11, Mar. 16, Nov. 16, 1812; Jan. 25, 1813; Jan. 9, 1815; Mar. 2, 21, 1816. In 1824 Mayor Josiah Quincy abolished the Board of Health; thereafter the bills were compiled by the superintendent of burials, who was directly responsible to the City Council. Josiah Quincy, *A Municipal History of the Town and City of Boston, during Two Centuries* (Boston, 1852), 71-73; Boston City Council, *The Charter of the City of Boston, and Ordinances Made and Established by the Mayor, Aldermen, and Common Council . . .* (Boston, 1827), 170-172. The bills have been reprinted in Boston Registry Dept., *Bills of Mortality, 1810-1849, City of Boston* (Boston, 1893).

[24] Walter Channing, "Bills of Mortality," *The New-England Journal of Medicine and Surgery, and Collateral Branches of Science*, XV (1826), 230-231.

[25] *Ibid.*, 225-234.

[26] "Bills of Mortality," *Boston Medical and Surgical Journal*, I (1828-29), 109-110; "Names of Diseases," *ibid.*, 205-207; "Boston Medical Association," *ibid.*, XII (1835), 225; "The Boston Bill of Mortality," *ibid.*, XIV (1836), 32-33; "Boston Medical Association," *ibid.*, LXII (1860), 311; "Boston Society for Medical Improvement: Report of the Committee on Diseases Prevailing from January 6, to May 25, 1832," *The Medical Magazine*, I (1832-33), 72.

tion, local medical journals began including accounts of the statistical work of English and French physicians, thus demonstrating the possibilities of a study of vital records.[27] Finally the Boston Medical Association in 1837 succeeded in persuading the City Council to adopt its nomenclature and to require death certificates from physicians.[28] Some practitioners nevertheless submitted returns "outrageously at variance" with the officially adopted nomenclature,[29] and the form of the bills of mortality remained unchanged. Moreover, despite all the objections to the quality of the existing statistics, D. Humphreys Storer appears to have been the only Boston physician who had as yet published a serious attempt to derive more satisfactory or comprehensive tables from the data already available.[30]

The developments in Boston during the 1830's reflected in some measure the interest which Europeans had manifested as men like Adolphe Quetelet and Louis-René Villermé presented the results of statistical inquiry lucidly, attractively, and meaningfully. While governments were improving official statistics—the British registration law of 1837 was especially notable—private statistical societies proliferated. In 1833 came the first of lasting importance in England, the Manchester Statistical Society, and the following year, as an offshoot of the newly formed British Association for the Advancement of Science, the Statistical Society of London (later the Royal Statistical Society) was founded. With the incorporation of the New York Statistical Society in 1836, the movement

[27] "Account of the Medical Statistics of Paris," *The New-England Medical Review and Journal*, I (1827), 426-433; Bisset Hawkins, "Abstract of Lectures on Medical Statistics, Delivered at the College of Physicians," *Boston Medical and Surgical Journal*, I (1828-29), 418-426, 438-443. See also, J. Ware, "Medical Statistics," *The Christian Examiner and General Review*, VII (1829-30), 240-261; "Comparative Health of the Principal Cities of Europe and America," *The Knickerbocker, or New-York Monthly Magazine*, IV (1834), 272-275.

[28] "Boston Bill of Mortality," *Boston Medical and Surgical Journal*, XVI (1837), 35; *ibid.*, XVI, 67; "Boston Nomenclature of Diseases," *ibid.*, XVI, 208-209.

[29] "Bill of Mortality," *ibid.*, XVII (1837-38), 209-210.

[30] "Medical Statistics and Bills of Mortality, for Boston, during Nineteen Years Ending January 1st, 1832," *Medical Magazine*, I (1832-33), 509-529, 576-598; "Medical Statistics and Bills of Mortality for Boston," *ibid.*, II (1833-34), 425-429. For an earlier, slighter compilation, see Nathaniel Niles, Jr., and John D. Russ, *Medical Statistics; or a Comparative View of the Mortality in New-York, Philadelphia, Baltimore, and Boston, for a Series of Years . . .* (New York, 1827). Both Niles and Russ had studied in Boston and the former had practiced there for several years. Neither was a resident in 1827. Howard A. Kelly and Walter L. Burrage, *Dictionary of American Medical Biography* (New York, 1928), 1070; Allen Johnson and Dumas Malone, eds., *Dictionary of American Biography* (New York, 1928-36), XIII, 524.

reached this country, and three years later a few leading citizens of Massachusetts, led by a Boston bookseller and publisher named Lemuel Shattuck, organized the American Statistical Association.[31]

Born in Ashby, Massachusetts, on October 15, 1793, of pious Congregationalist parents, Lemuel Shattuck grew up in New Ipswich, New Hampshire. A deeply religious young man, introspective, and painfully conscious of the sinfulness of mankind, he does not appear to have been a likely candidate for the role of public health reformer.[32] To his brother Daniel he wrote in 1816, "how often is man alive to day and a lifeless corps tomorrow. All these changes are the effect of infinite Wisdom. He disposes of our lot. And if we are lovers of him He will cause all things to work for our good."[33] Some months later he added, "Happy indeed is that disposition which acquieses with calmness in the sovereignty of its *Maker*, in treating us as his own, according to his divine *Will*."[34] As a schoolboy, however, he "took great delight" in doing "the sums in Adams and Pikes old arithmetics."[35]

Ever anxious to do good, Shattuck first embarked upon a teaching career, but, giving it up for reasons of health, in 1823 he went into business in Concord, Massachusetts. Becoming interested in local history

[31] Harald Westergaard, *Contributions to the History of Statistics* (London, 1932), 136-171; Walter F. Willcox, "Coöperation between Academic and Official Statisticians," American Statistical Association, *Publications*, XIV (1914-15), 281-286; idem, "Note on the Chronology of Statistical Societies," *Journal of the American Statistical Association*, XXIX (1934), 418-420; idem, "Lemuel Shattuck, Statist, Founder of the American Statistical Association," *ibid.*, XXXV (1940), 224-235; Samuel A. Green, "An Account of the Collections of the American Statistical Association," American Statistical Association, *Publications*, I (1888-89), 328-330; Carroll D. Wright, "Address . . . ," *ibid.*, XI (1908-09), 1-4; American Statistical Association, *Constitution and By-Laws* . . . (Boston, 1840), 3-14; idem, "Historical Exhibits," *Journal of the American Statistical Association*, XXXV (1940), 298-308. The New York Society, if ever fully organized, soon disappeared. The American Statistical Association, which was chartered by Massachusetts in 1841, published one volume of *Collections* in three parts in 1843-47, but although it continued to meet at least once a year had no regular serial publication until 1888.

[32] Lemuel Shattuck, Diary, Oct. 15, 1812, to Oct. 23, 1815; Journal, Jan. 8, 1816, to Oct. 15, 1817; and Autobiography (written 1844), MSS. in Lemuel Shattuck Papers, Massachusetts Historical Society. The most important biographical notices are in Lemuel Shattuck, *Memorials of the Descendants of William Shattuck* . . . (Boston, 1855), 302-312; John W. Dean, "Lemuel Shattuck," *Memorial Biographies of the New England Historic Genealogical Society*, III, 1856-1859 (Boston, 1883), 290-321; Walter F. Willcox, "Lemuel Shattuck, Statist, Founder of the American Statistical Association," *Journal of the American Statistical Association*, XXXV (1940), 224-235; Charles Hudson, "Memoir of Lemuel Shattuck," Mass. Hist. Soc., *Proceedings*, XVIII (1880-81), 155-165.

[33] Letter dated Aug. 19, 1816, Shattuck Papers.

[34] L. Shattuck to Daniel Shattuck, dated Troy, Dec. 13, 1817, Shattuck Papers.

[35] Shattuck, Autobiography, 16.

and genealogy, he discovered the imperfections of Massachusetts' registration of births, marriages, and deaths. After moving to Boston in 1834, he published in 1835 his first literary work, *A History of the Town of Concord,* which contained a notable chapter on statistics.

> Few subjects are more interesting [he commented] than accurate bills of mortality. They are the most authentic evidence of the influence of climate and local circumstances on health and human life; and teach a lesson, admonishing us of the destiny that awaits all mankind, and warning us "to live prepared to die." [36]

Elected as a Whig to the Boston Common Council for 1837, Shattuck sought to improve the city's registration system. Though unsuccessful, he persevered, for, as he wrote to a fellow statistician, "this subject, which I have under investigation, increases in interest as I dive deeper into it, and my wish is to have as many minute facts as I can obtain, that I might arrive as near perfect accuracy as possible." [37] In addition to some newspaper articles on the necessity of improving registration, he wrote an "able and uncommonly valuable" [38] paper "On the Vital Statistics of Boston," which appeared in *The American Journal of the Medical Sciences* in April 1841.[39] After describing the character and extent of the local records, Shattuck analyzed the available data, which seemed to show that the expectation of life was decreasing. He also pointed out that birth registration was almost nonexistent, and that although the number of deaths recorded was reasonably reliable, the diseases were not. The sex, age, place of nativity, and season of year, he maintained, should be stated in connection with the cause of death. The residence of the deceased should be recorded, so it would be possible to determine how far the "supposition" that certain localities and classes had higher death rates than others was "founded on fact." Indeed, the entire article evinced Shattuck's guiding conviction: "No correct conclusion can be made . . . , except by a careful examination of the facts." [40]

[36] *A History of the Town of Concord; Middlesex County, Massachusetts, from Its Earliest Settlement to 1832* . . . (Boston, 1835), 223. Shattuck had been elected to the Massachusetts Historical Society in 1830 and in 1844 was one of the founders of the New England Historic Genealogical Society. He maintained his interest in genealogy throughout his life.

[37] Letter to Luther V. Bell, dated Boston, Sept. 24, 1839, Shattuck Papers. Bell, the superintendent of the McLean Asylum in Charlestown, had shown much interest in statistical work.

[38] "Vital Statistics of Boston," *Boston Medical and Surgical Journal,* XXIV (1841), 179.

[39] See above, note 3.

[40] Shattuck, *Vital Statistics of Boston,* xxii, xxv. Note the reviewer's comment, "Mr. Shattuck evinces uncommon patience in systematizing a class of facts about which but

While Shattuck was investigating the statistics of Boston, the Massachusettts Medical Society—or rather a few of its members—was attempting to improve state-wide records, for the registration law, though re-enacted as recently as 1835,[41] was still generally ignored. Acting upon a motion originally proposed in July 1839 by Dr. Paul Swift of Nantucket, a committee of the Council in May 1840 recommended that the Society collect, compile, and publish mortality data for the entire state. Doubting that the legislature would or could afford effectual assistance, the committee preferred to rely on "the free and voluntary labors" of the members of the Society, who were "most directly interested" in full and accurate statistics, who were conscious of their present defects, and who were "most competent" to make the required changes.[42]

The committee appointed to carry out this plan soon realized that it was totally impractical and that legislative interference was essential. It is probable that Shattuck had some influence in this decision.[43] In February 1841, therefore, the Counsellors petitioned the General Court for a new and better law. Many questions "of great importance in political economy and other branches of science," they declared, might be elucidated by accurate vital statistics.

> But it is on account of its importance in promoting the public health, that your memorialists, as physicians, attach the strongest interest to this measure. Many of the causes of disease, as they affect different communities, engaged in a great variety of occupations, can only be ascertained by observations on an extensive scale, far beyond the reach of individual research. An accurate return of deaths from the different sections of the State, for a series of years, would greatly aid in the investigation of these causes, and would doubtless do much towards enabling us to find means for the removal of some of them.

The "valuable results" of the new English registration system, they added, furnished "the greatest encouragement to believe that results no less beneficial might easily be obtained among ourselves," and they assured the legislature of the "prompt and cheerful co-operation" of the medical profession.[44]

At the same time the American Academy of Arts and Sciences, also

very few people have any definite knowledge." "Vital Statistics of Boston," *Boston Medical and Surgical Journal*, XXIV (1841), 208.

[41] Mass. General Court, *The Revised Statutes of the Commonwealth of Massachusetts, Passed November 4, 1835* (Boston, 1836), ch. 15, sec. 47.

[42] Mass. Med. Soc., *Medical Communications*, VI (1837-41), Appendix, 77-78, 80, 87-89.

[43] Mass. Sanitary Commission (Lemuel Shattuck, et al.), *Report of a General Plan for the Promotion of Public and Personal Health* (Boston, 1850), 55.

[44] Mass. Med. Soc., *Medical Communications*, VI (1837-41), Appendix, 107-110.

prompted by Shattuck, lent its support. Its memorial, obviously drawn up after consultation with the Medical Society, pointed out the importance of vital statistics not only for "promoting the public health," but also for determining consanguinity and rights of property and for constructing life tables for insurance and similar purposes. Though the petitions were received too late for final action in 1841, a joint special committee of the House and Senate fully concurred "with the memorialists in their opinion as to the beneficial effects that would result from an efficient and thorough system of public registration." Between sessions both the Medical Society and the Academy continued to press the matter, and the former called upon its members to lobby for the proposed legislation with the representatives from their own districts.[45]

With the way thus prepared, the General Court on March 3, 1842, required town clerks to transmit annually to the Secretary of the Commonwealth the number of births and marriages registered within their respective jurisdictions, and the number of deaths together with the name, sex, and age, the cause of death, and for adult males the occupation. The Secretary of the Commonwealth was to prepare tabular results and submit a report to the legislature.[46] The first year's returns under the new law were disappointing. The act failed to provide additional machinery for collecting the original data, and the medical profession as well as the public often failed to co-operate. In Fall River, for example, the town clerk despite repeated entreaties could get no help from some of the principal physicians, because, they said, "it is too much trouble, and *correct* statistics cannot be obtained." Even a state senator, "who assisted in making the law, has rendered no assistance in its execution, although an M. D."[47] The act was nevertheless extremely important, for it first established the principle in this country that vital statistics should be returned to the state government for abstraction and publication. As the Medical Society's chief lobbyist pointed out, it did not provide all that had been hoped, but it might at least lead to a better system in the future.[48]

[45] Mass., Secretary of the Commonwealth, *First Annual Report to the Legislature: under the Act of March, 1842, Relating to the Registry and Returns of Births, Marriages and Deaths in Massachusetts* (Boston, 1843), 25-29; Mass. Med. Soc., *Medical Communications*, VI (1837-41), Appendix, 118-119.

[46] Mass., Secretary of the Commonwealth, *First Annual Report*, 29-30; Mass. *Acts*, 1842, ch. 95. Unfortunately sections in the original bill directing towns to appoint superintendents of burials, providing for their compensation, and requiring death certificates prior to interment were stricken out.

[47] Mass., Secretary of the Commonwealth, *First Annual Report*, 1-37, 58-59.

[48] Mass. Med Soc., *Medical Communications*, VII (1842-48), Appendix, 4-6.

Commenting on the *First Annual Report,* the *Boston Medical and Surgical Journal* declared that "Lemuel Shattuck, Esq., of Boston, is the man, of all others, who should be set apart by the Secretary, to collect, prepare and systematize the materials of this valuable annual publication." [49] Though the *Second Annual Report,* like the first, was actually compiled by Augustus A. Gould, M. D.,[50] it contained a letter from Shattuck discussing the value of adequate registration, the defects of the existing law, and the best way to improve it. [51] Furthermore, the lack of response to an elaborate plan for statistical investigations proposed by a committee of the Massachusetts Medical Society shortly thereafter again demonstrated the futility of relying on the voluntary endeavors of the profession.[52] Spurred by Shattuck's report, the General Court in 1844 improved the law to some extent.[53] But it still provided insufficient compulsions or rewards. Almost yearly the *Boston Medical and Surgical Journal* pointed out that registration would remain incomplete until the individuals charged with collecting and recording the information were paid for their services.[54] Shattuck again reinforced this and other points in the *Fourth Annual Report.*[55]

While writing this long and valuable dissertation on why and how vital statistics should be collected, analyzed, and presented, Shattuck was also preparing for the city of Boston a census which gave an object lesson in what a statistical report could and should be. After an introductory

[49] "Births, Marriages and Deaths in Massachusetts," *Boston Medical and Surgical Journal,* XXVIII (1843), 146.

[50] Mass., Secretary of the Commonwealth, *Twentieth Report . . . Births, Marriages, and Deaths, in . . . 1861* (Boston, 1863), v.

[51] Idem, *Second Annual Report . . . Births, Marriages and Deaths . . .* (Boston, 1843), 64-73.

[52] Mass. Med. Soc., *Medical Communications,* VII (1842-48), Appendix, 27, 36, 46-66, 70, 124, 154; C. C. Field, "Topographical Description of the Town of Leominster, Mass.," *Boston Medical and Surgical Journal,* XXX (1844), 337-340; "Public Hygiene," *ibid.,* 343-344; Mass. Sanitary Commission, *Report,* 166.

[53] Mass. *Acts,* 1844, ch. 159.

[54] "Registration of Births, Marriages and Deaths in Massachusetts," *Boston Medical and Surgical Journal,* XXXII (1845), 44-45; "Births, Marriages and Deaths in Massachusetts," *ibid.,* XXXV (1846-47), 539; "Influence of Occupation on Life," *ibid.,* XXXVI (1847), 45; "Births, Marriages and Deaths in Massachusetts," *ibid.,* XXXVII (1847-48), 403; "Births, Deaths and Marriages in Massachusetts," *ibid.,* XL (1849), 64; "Registration of Births, Marriages and Deaths," *ibid.,* XLII (1850), 43-44.

[55] Mass., Secretary of the Commonwealth, *Fourth Annual Report . . . Births, Marriages and Deaths . . .* (Boston, 1845), 67-106. See also, "Registration Law in Massachusetts," *North American Review,* LXI (1845), 250-253; "Registration of Births, Marriages, & Deaths," *The American Almanac and Repository of Useful Knowledge, for the Year 1846* (Boston, 1845), 152-157.

historical note, he tabulated the population by wards and sections, and classified it according to nativity, race, sex, and age. In addition he gave data on dwelling houses, water supply, marital condition, education, occupations, wealth, charities, pauperism, crime, moral and religious institutions, births, marriages and deaths, and public health.[56] Laudatory comment came from such diverse sources as the *Democratic Review*,[57] Hunt's *Merchants' Magazine*,[58] and *The American Journal of the Medical Sciences*.[59] The chapter on public health alone, according to the editor of the *Boston Medical and Surgical Journal*, was worth the cost of publication, and he conceded that " No medical man in New England has ever carried his investigations so far, or conferred a greater benefit in publishing statistical information." [60] Most gratifying of all, perhaps, was a personal letter from the great English statistician, William Farr. " I was very much pleased," he wrote, " with your Census of Boston. It is clear, well-arranged—and was evidently altogether well conducted." [61]

With this achievement behind him, Shattuck in 1848 again turned to the state's registration system. Pointing out its faults in a petition to the General Court, he submitted the draft of an act for consideration.[62] The following year, as a member of the state House of Representatives, he presented a lengthy and careful report advocating several improvements. Accurate and complete registration of births, marriages, and deaths, Shattuck wrote, would in the first place preserve the basic personal history of individuals, which was of interest to genealogists and necessary to establish various sorts of legal and political rights. Secondly, it would furnish the data for constructing accurate life tables, which were essential for life insurance and for determining the value of reversionary estates, annuities, dower rights, and so on. Thirdly, it would exhibit the physical condition of the people and demonstrate the effects of locality

[56] Lemuel Shattuck, *Report to the Committee of the City Council Appointed to Obtain the Census of Boston for the Year 1845, Embracing Collateral Facts and Statistical Researches, Illustrating the History and Condition of the Population, and Their Means of Progress and Prosperity* (Boston, 1846).

[57] *The United States Magazine, and Democratic Review*, n. s. XVIII (1846), 477-478.

[58] " Progressive Wealth and Commerce of Boston," *The Merchants' Magazine and Commercial Review*, XV (1846), 34-35.

[59] Review, n. s. XII (1846), 177-178.

[60] " Census of Boston," *Boston Medical and Surgical Journal*, XXXIV (1846), 362.

[61] William Farr to Lemuel Shattuck, dated General Register Office, London, Nov. 5, 1846, Shattuck Papers, Mass. Hist. Soc.

[62] " Memorial of Lemuel Shattuck Praying for a Revision of the Laws in Relation to the Registration and Return of Births, Marriages, and Deaths," Mass., *Senate Document*, No. 24 (1848).

and circumstances upon health and life. Fourthly, publication of the facts disclosed by registration would teach the public the laws of life, and, since many deaths were preventable, would ultimately lead to the diminution of disease and the extension of life. Hence, since sickness involved large pecuniary losses, registration would lessen poverty and increase the wealth of the people. And finally, since sickness led to moral degradation, unhappiness, and crime, and caused mental and physical care, anxiety, and suffering, registration would promote man's happiness and his intellectual and moral nature.[63]

With this forceful document before them, the legislators in May 1849 again revised the law.[64] Failing to include all of Shattuck's recommendations, the act was far from perfect.[65] Nevertheless, the effect of the amendments, and of additional administrative experience, may readily be seen during the 1850's in the steady improvement of the state's annual reports. A larger number of more detailed tables were printed. Registration became more nearly complete. Some attention was paid to estimating the extent of the error, and the report for 1858 strongly pointed out the common fallacy of judging the relative health of places or classes by the average age at death without reference to the age distribution of the living.[66] Particularly striking was the change in Boston's statistics. Though the superintendent of burials had continued to compile bills of mortality similar to the one first published in 1812, the city clerk had not even submitted the returns for 1844-48 to the state. Under the new act the City Council quickly established the office of city registrar, which soon began publishing its own annual reports[67] and in 1849 recorded a

[63] "Report of the Joint Special Committee of the Legislature of Massachusetts Appointed to Consider the Expediency of Modifying the Laws Relating to the Registration of Births, Marriages, and Deaths, Presented March 3, 1849," Mass., *House Document*, No. 65 (1849), 4-15.

[64] Mass. *Acts*, 1849, ch. 202.

[65] For a judicious and informed contemporary estimate, see Edward Jarvis, "Report on the Law of Registration of Births, Marriages, and Deaths," American Medical Association, *Transactions*, XI (1858), 527-535. For attempts at further reform, see Mass., *Senate Document*, No. 141 (1852); No. 80 (1855); No. 96 (1856); No. 46 (1858); No. 111 (1859); Mass., *House Document*, No. 50 (1853); No. 264 (1855).

[66] Mass., Secretary of the Commonwealth, *Seventeenth Report . . . Births, Marriages, and Deaths, in . . . 1858* (Boston, 1859), vii, 47-57. Lemuel Shattuck had already emphasized this fact in Mass. Sanitary Commission, *Report*, 139-141.

[67] City of Boston, "An Ordinance Providing for the Appointment of a City Registrar, and Prescribing His Duties," (Boston) *Daily Evening Transcript*, June 28, 1849; Boston City Registrar, *Report by the City Registrar of the Births, Marriages and Deaths, in the City of Boston, for the Year 1849* (Boston, *City Document*, No. 4, 1850).

larger number of births than in all the previous forty years together.[68] It was not until well after 1860 that the state reports became as satisfactory as the limitations of medical science and the ability of the average practitioner would allow, but the principle had been well established. The Massachusetts registration reports now comprise an unbroken series of more than one hundred years.

Aside from its importance for legal proceedings and insurance,[69] the advocates of registration had stressed its value primarily as a means of discovering the causes of diseases and thereby improving the public health. Occasionally medical men did employ the data collected under the new laws for investigating the epidemiology of some specific malady. During the cholera epidemic of 1849, for example, the Boston city physician, Dr. Henry G. Clark, obtained from the registrar a record of the residence of each fatal case and constructed a spot map which clearly demonstrated the concentration of the disease in certain particularly crowded and unsanitary areas occupied primarily by proverty-stricken Irish immigrants.[70]

Most of the work of this period, however, treated the picture more broadly. Reporting to the American Medical Association in 1849, Dr. Josiah Curtis of Lowell showed from the state registration reports that in Massachusetts (outside the capital) consumption, "typhus" fever, and dysentery together caused more than one-half the total mortality, and elucidated the relationships of these diseases to age and season. He based his remarks on the health of the Lowell factory workers on statistical data, and considered such factors as the age distribution of the living and the excessive mobility of that town's population.[71] The following year

[68] Idem, *Report . . . Births, Marriages, and Deaths, . . . 1852* (Boston, *City Document*, No. 10, 1853), 20, 27.

[69] For the use of Massachusetts vital data for the construction of a life table, see especially E. B. Elliott, "On the Law of Human Mortality that Appears to Obtain in Massachusetts, with Tables of Practical Value Deduced Therefrom," American Association for the Advancement of Science, 11th Meeting, Montreal, 1857, *Proceedings* (Cambridge, 1858), 51-82.

[70] Boston, Committee of Internal Health, *Report of the Committee of Internal Health on the Asiatic Cholera, together with a Report of the City Physician on the Cholera Hospital* (Boston, *City Document*, No. 66, 1849), 163-180.

[71] Josiah Curtis, "Public Hygiene of Massachusetts; but More Particularly of the Cities of Boston and Lowell," American Medical Association, *Transactions*, II (1849), 487-554. See also *Boston Medical and Surgical Journal*, XLII (1850), 96-97. In the registration reports and, therefore, in Curtis's paper, "typhus" fever still included both typhus and typhoid. The incidence of the latter, at least outside Boston, was unquestionably much higher. Note, for example, that the seasonal distribution pointed out by Curtis (p. 489) is typical of typhoid.

Dr. Edward Jarvis of Dorchester, one of Massachusetts' ablest statisticians, discussed the quality and quantity of available data and derived indications with respect to the relative incidence of various classes of diseases, and the relative longevity of city and country, of the United States and European nations, and of persons of differing economic status.[72]

During the 1840's and 1850's, however, the records were still so fragmentary and faulty that statisticians could do little more than illustrate and emphasize theories which had long existed. As Dr. E. H. Clarke pointed out, pure air, exercise, and cleanliness had been considered indispensable to health since the days of Hippocrates, but until lately no data showed with exactness how much waste of life there actually was.[73] The chief value of vital statistics at this time was to promote sanitary reform by convincing skeptics that existing evil conditions caused a large amount of unnecessary sickness and death and that the government could and should undertake preventive measures.

Thus Josiah Curtis pointed out in the tenth registration report that the so-called zymotic diseases caused more deaths than any other class. "This ought not to be," he wrote, "inasmuch as it embraces just those maladies which can most easily be prevented by proper preventive measures."[74] Though the cholera epidemic of 1849 had aroused great fear, dysentery had in that very year caused twice as many deaths.[75] The mortality tables, he declared, "show in rugged and unmistakable outlines that large numbers of valuable lives are sacrificed annually in the State, which, with proper sanatory improvements, . . . might have been saved." Great advantages would accrue to the public from "a complete system of health measures, such as it is within the province of legislators to require, and in the power of the people to adopt." But first the public must become "acquainted with the lessons which our system of registration is teaching, by having them presented in plain and comprehensive language. . . . When the facts on this subject become generally known among our citizens. . . . they cannot fail to awaken public sentiment and enlist a

[72] Edward Jarvis, "Sanitary Condition of Massachusetts and New England," American Medical Association, *Transactions*, III (1850), 247-266.

[73] E. H. Clarke, "Sanitary Reform," *North American Review*, LXXIII (1851), 118.

[74] Mass., Secretary of the Commonwealth, *Tenth Report . . . Births, Marriages, and Deaths, in . . . 1851* (Boston, 1852), 92. Defined as "epidemic, endemic and contagious" diseases, the zymotics then included cholera, cholera infantum, croup, diarrhea, dysentery, erysipelas, fever (unspecified, intermittent, remittent, and typhus), whooping cough, influenza, measles, scarlatina, smallpox syphilis, and thrush. *Ibid.*, 38-39, 92.

[75] *Ibid.*, 93.

universal interest . . ." While reports of "impoverished and famished Ireland," and "pictures of agglomerated vice and filth, spiritual and physical depravity," in the slums of Liverpool or London aroused the sympathies of many Americans, he noted, they failed to realize that equally bad conditions existed in Lowell and Boston. Great Britain and France had already demonstrated that sanitary reforms decreased sickness and mortality.

> When our own people learn this from practical legislation [he concluded], as England has done, some thousands of lives, on a moderate calculation, will be saved annually, in the cities of the Commonwealth, the physical power of the State will be elevated, and the health, happiness, moral dignity, and intellectual greatness of our citizens will be equally augmented.[76]

In the report for 1859, Curtis pointed out that if the annual death rate in Boston for that and the previous year had been 17 per 1,000—only a fraction below that of the state as a whole—1,705 persons needlessly sacrificed would have been rescued from death. Where else, he asked, could the Christian philanthropist, the political economist, or the enlightened statesman do more good?

> It is not so much the unusual prevalence of any epidemic, which is temporary [he concluded], as the usual number of excessive deaths to which we have become accustomed, that in the aggregate, destroys the lives of such numbers of our fellow beings. No well-informed person can contemplate the lack of sanitary measures on the part of municipal authorities and individuals, so clearly manifest in all of our cities, without the most convincing evidence that *a great work is yet to be done*, for which nature offers as a premium, the salvation of thousands of human lives and relief from an untold amount of sickness, besides the incalculable pecuniary as well as moral benefits which would necessarily flow therefrom.[77]

While Curtis's observations were buried in official reports, Dr. Edward H. Clarke presented in the influential *North American Review* some particularly striking figures which he had compiled from the 1850 death registration data for Boston. In the wealthy section of Beacon Hill the mortality rate was only 13 per 1,000; in a middle-class area on Back Bay, it was 19 per 1,000; and in the crowded, filthy tenements of Broad, Cove, and Sea street, it was 56.5 per 1,000. Although these differences

[76] *Ibid.*, 107-114.

[77] Mass., Secretary of the Commonwealth, *Eighteenth Report . . . Births, Marriages, and Deaths, in . . . 1859* (Boston, 1861), 47-52. See also Curtis's comments in idem, *Eighth Report . . . Births, Marriages and Deaths, . . . from May 1, 1848, to Jan'y 1, 1850* (Boston, 1851), 101-124.

resulted in part, he believed, from the personal habits of the people, a fearful responsibility nevertheless rested upon the community until such pestilential areas were cleansed.[78]

Clarke's article was an extended review of this period's most far-reaching publication on sanitary reform, Shattuck's great *Report of a General Plan for the Promotion of Public and Personal Health*. The immediate genesis of the document was a petition for a sanitary survey presented to the state legislature in 1848 by the American Statistical Association. Though the memorial effectively used statistical data in support of the contention that such an investigation was necessary and proper, the General Court declined to do more than publish the petition and refer it to the next session. The following year Shattuck, as chairman of the committee which reconsidered this petition and a supporting one presented by the Massachusetts Medical Society, recommended the appointment of a sanitary commission. This time the General Court approved. The governor early in July picked Shattuck and two other men (neither of whom contributed significantly), and on April 25, 1850, going far beyond the expectations of the original petitioners, Shattuck presented his monumental report.[79]

"The most important laws for ascertaining the facts regarding the sanitary condition of the State," he wrote, ". . . are those relating to the registration of births, marriages, and deaths." [80] Using the data gathered under the state registration laws, together with earlier figures collected by Boston and a few other towns in Massachusetts, Shattuck showed that the average annual crude mortality rate for Boston (in 1841-49) was 25.3 per 1,000, compared to a rate of 14.9 (in 1826-35) for a group of country towns. Nor was this attributable to differences in age composition, for the country towns had a more favorable record in every age group. Furthermore, the death rate for all age groups in Boston except those from thirty to fifty and over ninety had increased during the past fifteen years. After considering statistically the influence of season, occupation, and marital condition upon mortality rates, Shattuck discussed the effect of disease, "the most important test of the sanitary condition

[78] E. H. Clarke, "Sanitary Reform," *North American Review*, LXXIII (1851), 121-123.

[79] "Petition of the American Statistical Association," Mass., *House Document*, No. 16 (1848); "Report of the Joint Special Committee on the Memorials for a Sanitary Survey of the State," Mass., *House Document*, No. 66 (1849); Mass. Sanitary Commission, *Report*, 3-4; Edward Jarvis, "Report of the Sanitary Commission of Massachusetts," *Boston Medical and Surgical Journal*, XLIV (1851), 89-90.

[80] Mass. Sanitary Commission, *Report*, 55.

of the State." The extent to which the zymotic diseases prevailed, he declared, was "the great index of public health." And in Boston they had since 1810 caused an increasingly large percentage of the total number of deaths, showing that "the public health has been constantly growing worse." [81] The facts he had presented, Shattuck declared, proved that longevity varied greatly in different places and under different circumstances; that causes producing premature and preventable deaths existed throughout the state; that legislative, social, and personal preventive measures were not applied as extensively as they might be; "that the active causes of disease and death are increasing among us, and that the average duration of life is not as great now as it was forty or fifty years ago." [82] He therefore recommended the creation of state and local health departments, extensive sanitary improvements, and many other public health measures. Though the General Court failed to establish a State Board of Health until 1869, its first secretary looked back to Shattuck's report "as his inspiration and support." [83]

The development of vital statistics in Massachusetts was greatly influenced by events in Europe, especially England. Other states in the Union, moreover, followed Massachusetts' example. New York passed a registration law in 1847, Connecticut and New Jersey in 1848, New Hampshire in 1849, and Pennsylvania and Kentucky in 1852. By 1860 several others had followed suit.[84]

Nor was this movement isolated from other phases of the history of the time. Political democracy was advancing: all the new western states entered the Union with white manhood suffrage, and in the East property requirements for voting were being eliminated. Radical Democrats, de-

[81] *Ibid.*, 82-101.

[82] *Ibid.*, 102-105. For some statistical arguments for approving the plan, see *ibid.*, 244-245, 248-249, 280-281, 283-284.

[83] Henry I. Bowditch, *Public Hygiene in America* (Boston, 1877), 32.

[84] Mass., Secretary of the Commonwealth, *Tenth Report . . . Births, Marriages, and Deaths, in . . . 1851*, 73; idem, *Sixteenth Report . . . Births, Marriages, and Deaths, in . . . 1857* (Boston, 1858), 165 n; Josiah Curtis, "On the System of Registration in the United States of America," *Journal of the Statistical Society of London*, XVII (1854), 43-44; Edward Jarvis, "Report on the Law of Registration of Births, Marriages, and Deaths," American Medical Association, *Transactions*, XI (1858), 535. Shattuck's direct influence in connection with some of the other states' laws (as well as the census of 1850) may be seen in letters in the Shattuck Papers in the Mass. Hist. Soc. For a general review of contemporary data, see James Wynne, *Report on the Vital Statistics of the United States, Made to the Mutual Life Insurance Company of New York* (New York, 1857). Most of the early registration laws were subsequently repealed or ignored. Bowditch, *Public Hygiene in America*, 66-69, 111-117, 172-173.

manding equal opportunity for all, sought to abolish special privileges for the wealthy and centered their attack on the money power of the banking fraternity. Humanitarian movements flourished: prison reform, women's rights, public education, personal hygiene, the abolition of slavery. The most passionate devotees of some causes often attributed panacean powers to their particular crusade. Temperance reformers, for example, declaiming against drink as the root of all evil, expected moral suasion or legal prohibition to end crime, sickness, poverty, and vice.[85] "He who imports, manufactures, or sells alcohol, as a beverage," thundered *The Christian Examiner*, "imports, manufactures, and sells that which . . . produces and increases disease; that which feeds the pestilence; that which causes almost all the poverty and crime in the community; that, in fine, which sweeps thousands and tens of thousands into a premature grave."[86]

In some measure the development of statistics of all sorts fostered the climate of reform. They helped demonstrate needs in many fields and provided some of the facts necessary for intelligent action. They also showed that many social phenomena exhibited a regularity which seemed to prove they were subject to general laws. In the eighteenth century Johann Peter Süssmilch argued that statistical regularities proved the existence of an unchanging divine order.[87] But the nineteenth century's humanitarian spirit, its belief in the progress and perfectibility of man, its view of God as a loving Father rather than a wrathful Jehovah, made it inconceivable that such laws precluded the possibility of improving society. Sanitarians, for example, believed that since statistics seemed to prove that certain results followed directly from certain conditions in society, reforming the conditions would inevitably advance the welfare of man. Exemplifying this attitude, and in contrast to his youthful letters, Shattuck wrote in 1845:

[85] Arthur M. Schlesinger, Jr., *The Age of Jackson* (Boston, 1945), *passim*; Merle Curti, *The Growth of American Thought* (New York, 1943), 295-396; Alice Felt Tyler, *Freedom's Ferment* (Minneapolis, 1944), 225-547; Hebbel E. Hoff and John F. Fulton, "The Centenary of the First American Physiological Society Founded at Boston by William A. Alcott and Sylvester Graham," *Bulletin of the Institute of the History of Medicine*, V (1937), 687-734; Richard H. Shryock, "Sylvester Graham and the Popular Health Movement, 1830-1870," *Mississippi Valley Historical Review*, XVIII (1931-32), 172-183; John A. Krout, *The Origins of Prohibition* (New York, 1925), 227-237, 264, 297-304.

[86] "Traffic in Ardent Spirits," *The Christian Examiner and General Review*, XIV (1833), 30-31.

[87] Compare the title of his great work, *Die göttliche Ordnung in den Veränderungen des menschlichen Geschlechts, aus der Geburt, dem Tode und der Fortpflanzung desselben erwiesen* (4th ed., Berlin, 1775-76), first published in 1742.

We know that we all must die; but the time of our death we do not know. It may come comparatively soon; it may not. We believe, however, that the time of our death, though unknown, is in some respects within our own control. We believe that disease and death come not from a mysterious, unconditional Providence, but are the result of the condition of our bodies, and the influences that are brought to bear upon them.[88]

Compare the statement of a Massachusetts physician in 1851:

It is the death of the young, the premature blighting of the flower in the bud, which, more than any other affliction, requires for its consolation the exercise of the highest Christian faith. The instincts of nature refuse to believe, that because such trials are permitted by the Great Disposer of life, they were therefore intended always to exist. From the details of sanitary science, from the forbidding statistical columns of Health Returns and Registration Reports, we learn the comforting lesson, that these saddest of all afflictions are owing more to the transgressions of man than to the decrees of Providence. Thousands die annually before their time, and tens of thousands waste much of their lives on beds of sickness, not by the inscrutable purposes of their Creator, but because the noisome atmosphere of uncleanliness, disease, and death has been allowed to gather and float about them, till the lamp of life has gone out.[89]

Having found that statistics proved the existence of laws of health, statisticians demanded still more and better statistics so they could find out what the laws were and discover the conditions that led to premature sickness and death. Their expectations were too high. Statistical analysis alone, though vastly improved since Shattuck's day, has been far from sufficient for determining the causes of disease. But they were correct in their faith that statistics were one of the esssential weapons for improving the public health.

At the time, the marked conjunction of high mortality rates, density of population, and lack of sanitation actually served to reinforce the existing theory that filth *per se* was a cause of disease. An ancient idea, statistics seemed to prove it, and rendered the evils of insanitation incontrovertible. Statistics were expected to be the chief technical weapon of the sanitary reform movement, and they provided its most telling arguments. Like other reformers, advocates of the registration of births, marriages, and deaths promised that acceptance of their program would not only improve

[88] Mass., Secretary of the Commonwealth, *Fourth Annual Report . . . Births, Marriages and Deaths*, 91.

[89] E. H. Clarke, "Sanitary Reform," *North American Review*, LXXIII (1851), 117-118. See also, Edward Jarvis, "Law of Physical Life," *The Christian Examiner and General Review*, XXXV (1843), 1-31; C. Brooks, "Massachusetts Sanitary Survey," *The Christian Examiner and Religious Miscellany*, L (1851), 381-400.

the public health, but would also reduce crime, poverty, and other social evils, and increase the wealth, morality, and happiness of mankind. If, like other reformers, they were excessively sanguine, if their propaganda brought little change in public health administration prior to the Civil War, they nevertheless were in the forefront of the public health movement, and as such were in the long run among the most influential reformers in an age of reform.

A PLEA FOR CONSTRUCTIVE SPECULATION *

E. G. D. MURRAY

There is no sufficient reason why I should have been invited to give this paper. Such limited searches as I have made in the history of bacteriology have been adventitious and are of much too restricted and technical application to be of general interest. Thus I feel like a mounted specimen placed before the American Association of the History of Medicine that they may see an example of those gropers in the dark corners of laboratories whose work forms part of the pattern in the story of medicine. If therefore what I have to say is neither to your taste nor appropriate to this Society may I disarm your criticism by apologising in advance.

Lesser men than the Pharaohs have been interested in their own tombs, and, as the history book is the sarcophagus of the deeds of men, researchers may show a reasonable interest in the manner of funeral wrappings historians may give their work. Not being one of those who will have a personal niche, I am most concerned that bacteriology has not received due recognition for the vast range of influence it has exercised in so many realms of human endeavour. Even limiting the enquiry to the confines of medicine, it would be hard to deny the statement that no other single subject has contributed so much to medical achievement, for there is hardly a specialty which can ignore it, and mass mortality or the sum of single deaths or time wasting disease are still, as ever before, predominantly infections. The reduction or cure of these, together with the control of diseases of crops and domestic animals, the preservation of foods from deterioration, the production of antibiotics, and much of the vitamin situation are among many other bacteriological contingencies of medicine. It cannot even be said that bacteriology lacks high financial significance, for, apart from implication in many industries, antibiotics alone are very big business. It is astounding that this tremendously influential human achievement should be so neglected, that, to my knowledge, there is not a single adequate History of Bacteriology.

Without doubt, a similar complaint could be made by the protagonist of any other specialized subject. Perhaps the degree of modern technicality wrapped in a restricting terminology and dispersed through an ever en-

* Read at the twenty-seventh annual meeting of the American Association of the History of Medicine, New Haven, Connecticut, May 8, 1954.

larging stupendous literature is responsible for the eschewal of a task few could undertake. But the paucity of stirring currents of inspiring interpretation is allowing a form of stagnation in the mounting accumulation of scientific literature. The dead-storage of information in books on shelves can only become real knowledge when it is processed in a mind of constructive analytical power and vitalizing subtlety.

The historian, I suppose, must be distinguished from a mere compiler or a teller of tales, and, on etymological grounds, should be regarded as the learned wise one. Even so, does he as a rule do much more than construct a methodical formal record of the past? Although he may be so rarely gifted as to put before us a vivid picture of people and events and from it draw a lesson to stir our feelings to their depths, does he consistently purpose to effectively ponder the trends of the new, relating them to the lessons of the old and point a reasoned way to the future? The fading light of the past only very dimly lights the future and it is only the immediate trends that show where we are going, if we can recognize them and temper them not too strongly with the perspective of the past. The plague of Athens in the Peloponnesian War, though described by Thucydides with startling realism, is not identified to everyone's agreed satisfaction; thus it serves more as an extraneous though important factor in the destruction of the Athenian Empire State and offers little more than that to the history of medicine. There is no question of disparaging an understanding of the circumstances and lore of the past, or of balancing it against the vaunted utilitarianism of the present, but rather to protest against a limning that is little more than what Matthew Arnold described as " pillaging an antiquity of which he does not fully possess the secret." Even with this warning and with every care to scan the past with a carefully conditioned antique eye, there is the threat of the fossilizing dictum of Augustine Birrell that " History is a pageant and not a philosophy," which forces some of us, resentfully, with Oliver Wendell Holmes, to sit back on our ischial tuberosities to view the procession.

Whatever delight may be found in faerye, in the dire compleccioun of humours and biles, the blood of frogs fresh killed and the wondrous prescriptions of the XIV Century including " a woud hundys here," though we may sigh for the loss of so much that could happily have been preserved to us, we turn hopefully to the present eager turmoil of factual and experimental medicine. There, in the vast accumulation of integrated and verifiable information we find infiltrations that some of us incline to recognize as malignant, hypotheses and observations so intimately inter-

twined that they could not be unravelled by Psyche herself, and startling concepts with which we could by "stress" rival Katterfelto "with his hair on end at his own wonders." All this leaves the impression that each extreme is afflicted by a form of blindness peculiar to itself, and, if this be true, we can remember with advantage that "the blynde etyth many a flye."

The very finest work in scientific medicine is more readily misinterpreted in terms of financial gain and claims of quick cures of undiagnosed cases, rather than advanced by authoritative explanation of principles and vital processes, as our over-filled waste-paper baskets testify every day. It is depreciatory that these elaborate advertisements are often accepted as a source of information by practitioners (with added expense to the patient who ultimately pays for them) and it indicates a glaring defect in policy of medical journals. Nearly as pernicious is the unbalanced reporting of "medical news" in the daily press, in which inaccuracies develop a compound distortion by papers copying one from another. It may be said that this is not history; but to me this could be quick and urgent history whereby both professional and lay opinion might be influenced to great and permanent good. The happenings of the past hour are just as much history as the events of 2000 years ago, with this advantage that verification should be easier and contributing circumstances more truthfully appreciated. "Such is the Might of Time."

What is required, is not a new Journal of Preter-History, but an article on either quick or old history in every number of each reputable medical journal, or at least of the nation-wide journals. If space is required, the wise Editor could well postpone many an uninformative case report in order to establish a feature.

It is unlikely anyone will deny that such writing should be constructive and it is more than likely the majority will concede that reasoned speculation for professional groups stirs differences of opinion, stimulates research and introduces interest in progressive therapeutic measures. This is the purpose of scientific reviews, but they are usually highly specialized, not only assuming a familiarity with technical concepts but also the possession of a vocabulary nothing would dissuade the author from displaying, even if by refraining he could reach a wider circle of understanding readers. "'When I use a word' Humpty Dumpty said, in rather a scornful tone 'it means just what I choose it to mean—neither more nor less.' 'Impenatrability! That's what *I* say.'" But more is needed than a translator who brings together voluminous researches of the order that tell you

exactly how many full stops are contained in a ten-cent bottle of ink. A critically discriminating intellect is required to find determining principles in seemingly widely different fields of research, and, to the relations between these interpretations, add constructive speculation which fires imaginative enthusiasm. Of such was the mettle of Jacob Henle's "Miasmata and Contagia," even casting before their time "Koch's Postulates."

When anyone suggests that a committee should be appointed, it is always well considered to name that man chairman, in order that he shall write the report. Guessing that a comparable thought is the most likely feeling this paper will provoke, I propose to attempt to practice my preaching. This must be brief and limited to small things in my small world, but it will serve as an example.

Working with a strain of the protozoon *Paramecium aurelia,* Sonneborn showed there to be a microscopically demonstrable cytoplasmic character associated with a secretion which killed other cells not possessing it. The inheritance of this character proved to be cytoplasmic, dominant and independent of the nuclear gene which controlled it, which is also dominant. Thus cells can inherit the killer controlling gene without inheriting the killer cytoplasmic element and under environmental conditions the nucleus and the cytoplasmic particles multiply at different rates, so that cells with and without the controlling nuclear genes can be developed free of the cytoplasmic killing element.

Sonneborn has also discovered in *Paramecium* immunologically specific antigenic types. The determining antigens are invisible cytoplasmic characters and again are inherited independently of the nuclear genes. Under the influence of the corresponding type specific immune serum any one cytoplasmic antigenic type is changed to another and breeds true, even though there may not be any alteration of the genes. In this instance environmental temperature and nutritive influences assist the transformation and the maintenance of the new type. However, the nuclear genes control the capacity of antigenic transformation but the selection to which antigenic type the change will be made is determined by the cytoplasm.

This extra-chromosomal inheritance with its gene determinants, is of absorbing interest to the geneticist. Except for leaf variegation in relation to cytoplasmic plastids and for a few others in plants, also one such instance in an insect, *Drosophila,* and a respiratory enzyme cytoplasmic inheritance in a yeast, little is known of this exciting phenomenon.

J. Cuningham over 1925 to 1937 showed that *Borellia carteri* produced

an abrupt and massive transformation of antigenic type with each relapse in the Indian Relapsing Fever. He could maintain the serological type of the spirochaete constant in his experimental animals by quick passage precluding relapse and proved its relation to the development of type specific antibodies. Re-infection was determined by the type and the active or passive type immune body.

There is no recognized evidence of cytoplasmic inheritance in bacteria and up to now their antigenic changes are considered as a gradual establishment of a few mutants and not a mass transformation of a majority of cells. Cunningham's work seems to have been overlooked though the seemingly massive and abrupt change of type in the spirochaete with each relapse indicates a cytoplasmic influence. Thus, it is constructive to speculate on relapsing fever being an instance of cytoplasmic inheritance in a bacterium, which in turn plays a significant part in producing a singular clinical character.

The explanations such a process would afford, to many problems in immunology, epidemiology, and the processes of disease, intrigue the imagination. There is also a hint of this process bearing upon the explanation of the purpose of antibiotics in the cells which produce them and perhaps illuminate the action on the cells they are used to inhibit; in the present therapeutic rage antibiotics tyrannize, "'tis a consummation devoutly to be wish'd."

With development of arguments on the autocatalytic features of certain of the studied instances of cytoplasmic inheritance and making comparisons with the criteria for recognition of an intracellular virus, together with the remarkable feature of gene control, stirring problems of intracellular physiology are evoked, which would raise the importance of the cytoplasm to new significance in pathology. Add to this the unpredictable possibilities conjured up by the finding that toxin production by the diphtheria bacillus is closely linked to its being infected with a specific bacteriophage. Symbiosis modifying cytoplasmic physiology so becomes a factor in pathogenicity and the question could be re-opened as to which organism is the actual cause of diphtheria. Symbiotic exchange of food material as in *Convoluta roscofensis*, is far eclipsed by this pathogenic symbiont parasitism involving a third party.

To speculate further and less tangibly, the neglected observations of Webster on breeding mice with a greatly raised resistance to *Salmonella typhimurium* infection, with at the same time strictly parallel tolerance to mercuric chloride, and with the converse giving an identical result, the

whole question of the inheritance of susceptibility and resistance to infection is posed to the geneticist, the pathologist, the bacteriologist, and the physician.

What I wish to indicate by this example is, that a single observation reviewed in the light of happenings of the immediate past may reveal multiple pathways to the future in a most alluring way. My personal limitations confine me to examples of restricted character, but historians with a natural aptitude trained to caution in speculation may be expected to range constructively over an unlimited field. But if we must have processions may I plead for an occasional one to be replaced by a "Furry Dance." My excuse for this infliction by an outsider is that "some professions, law and medicine for example, are still in a state of evolution, inasmuch as no expert in them seems to be quite sure that he can win a case or cure a cold."

HOWARD DITTRICK

1877–1954

MEDICO-HISTORICAL NEWS AND ACTIVITIES

CORRESPONDENCE AND REPORTS

HOWARD DITTRICK (1877-1954)

Six years ago in this journal a corner in Paradise was forecast for Josiah Trent of beloved memory. It was forecast by the man who is surely there with him now, and they talk happily, we like to think, of mutual friends and interests and of all the joys which a life lived radiantly can bring and give.

The life of Howard Dittrick is overwhelming proof that the busiest of practising physicians can advance in measure incalculable the study of the history of medicine. Canadian by birth and trained in medicine at the University of Toronto, he came to the United States in 1900. In all the years that followed, as intern in gynecology and later resident at Lakeside Hospital, as physician to the proudest native of Cleveland and to the newest immigrant from Europe, as editor of the *Bulletin of the Cleveland Academy of Medicine* and of *Current Researches in Anesthesia and Analgesia*, as Director of the Editorial Department of the Cleveland Clinic on his retirement from private practice in 1943, he felt always the compelling lure of the history of his profession.

The historical seeds he sowed were varied, the harvest was and is and will continue to be rich. His books and articles and reviews are known to readers of this journal, who recall with particular pleasure the papers on the nursing can, on old hospitals in Spain, on medical fee bills, and on Chinese medicine dolls. He served the Association faithfully as a member of its Nominating Committee, of the Executive Committee of the Council, of the Committee on Research in the History of American Medicine, and of the Committee on the Care of the Records of the Association; as Secretary in the difficult post-war period; and as Delegate to the International Congresses of the History of Medicine in Spain in 1935 and in Yugoslavia in 1938. He worked actively for the Ohio Committee on Medical History and Archives. But his greatest historical monument, appropriately called after him since 1945, is the Howard Dittrick Museum of Historical Medicine which he founded in the city of his adoption in 1926. It started as a single room and slowly attained through his labors, patience, and vision, and in spite of budgetary limitations, the position of eminence which it now holds in the medical world. Its influence on students in the generations to come can be enormous.

As a part of the Cleveland Medical Library Association, the Museum specializes properly in early medicine in and around Cleveland. No one who worked with Dr. Dittrick can ever forget the enthusiasm with which he scoured the countryside for finds, the joy and exuberance with which he brought back triumphantly a mortar and pestle, a saddlebag kit, an old instrument which he had cajoled away from some retired physician. His Museum tells also, however, the wider story of medicine in place and time and so rightfully includes, for example, a Korean

medicine-chest, an unrivaled collection of Aztec pathological figures, copies of Pompeian scalpels, the twine-box of Dr. Oliver Wendell Holmes, a pharmacy jar from Faenza. The trips to Spain and Yugoslavia proved particularly fruitful, and the catalogues and wares of antique dealers in this country and abroad were always carefully scrutinized. The Howard Dittrick Memorial Fund for the Museum has now been established for the continuance of his work, and he himself selected, in time to train him, the young physician who was to succeed him as Director of the Museum.

The devoted partner in all these enterprises was Mrs. Gertrude Moore Dittrick. Together with him she washed and polished one by one the Museum's objects, together with him she shifted heavy cases, laid monk's cloth on shelves, and arranged exhibits. They reared six fine sons; he lies now beside the seventh on a knoll not far from the grave of Harvey Cushing. He faced with courage carcinoma of the colon and the invasion of the liver. "I have had 7 transfusions in preparation for the operation and am feeling much stronger. Who wouldn't be with Gertrude close at hand for encouraging support?" She had helped him in his work and in all else long after her failing eyesight really permitted, and she goes on since 11 July 1954 determined to "cast no shadow" on the lives of those about her.

The secret is that both were always dedicated to the concept that besides making a living in this world we must also "live a life." Fortitude, buoyancy, modesty, deep religious faith, kindliness, a love of books—these were qualities which shone from him. And since he was living a life, his friends will recall also the smaller and so very human things—his pride in his new power lawn mower, the cheerful doggerel which he turned out gleefully on the occasion of a friend's birthday or anniversary, his joy in his elms and in the nuthatches and robins which frequented them, his zest in painting the clapboards of his house or whitewashing its cellar, the skill of his hands not only in surgery but also in upholstering a chair or mending a toy for a grandson.

It is all there in the smile; the photograph reveals the man as words can never do. We go on proud and honored to have known him, wondrously warmed by his enthusiasm, and hoping ever so humbly to be worthy of the trust he left behind.

DOROTHY M. SCHULLIAN

LEWIS JEFFERSON MOORMAN (1871-1954)

The death of Lewis J. Moorman on August 2, 1954, brought to a close an interesting and picturesque career. Dr. Moorman settled in Oklahoma before it had reached the status of statehood, at his life's end, Oklahoma was a respected member of the union, possessing an excellent university and medical school. Dr. Moorman took a prominent part in all these events, and, as a teacher for twenty years and later as Dean, he left a lasting impress on the medical school.

Lewis Jefferson Moorman was born on a farm near Leitchfield, Kentucky, on February 9, 1871. After graduating at Georgetown College with the degree of B. S., he entered the University of Louisville School of Medicine. At that time Dr.

Moorman writes: "Many of the Louisville medical students were from the Southwest, with a large quota from Texas. Some of them were lone rangers with long whiskers; others were trim, lithe, sinewy cowboys with colorful pasts, vociferous tongues and alcoholic leanings." Possibly contact with these picturesque representatives of the Southwest gave young Lewis Moorman a desire to see their native habitat. At any rate, in 1901, soon after he received his M. D. degree, we find Moorman in El Reno, Oklahoma Territory, taking a chance on the gigantic land lottery, authorized by President McKinley. The prizes in this lottery were 13,000 farms, and 160,000 people journeyed to El Reno to record their names. Moorman was unsuccessful in the lottery but decided to locate in Jet, Oklahoma, where he lived the strenuous life of a pioneer doctor for six years. At the end of this period, he went to Vienna, where he sat at the feet of Schlesinger, Tandler, Von Noorden, Falta in the halcyon days of pre-war Vienna.

After his return from Vienna, Dr. Moorman located in Oklahoma City, which had shown astonishing changes from "the physical shortcomings and the crudities of the pioneer city," which had impressed him only six years before. Moorman became more and more interested in diseases of the chest, particularly tuberculosis, and, finding facilities limited for treating such patients, was instrumental in building up the Oklahoma Cottage Sanatorium and then the Moorman Farm Sanatorium, the main building of which had been formerly the clubhouse of the Oklahoma City Country Club. With the years, his standing and eminence as an expert on tuberculosis increased, and he attained national and international stature. He was president of the National Tuberculosis Association in 1943-44 and of the American Trudeau Society in 1940.

Dr. Moorman's interest in the history of medicine was life long. As professor of clinical medicine and later as dean of the University of Oklahoma School of Medicine, he impressed on his students the value of medical history and used the historical approach in emphasizing the fundamentals of medicine. He was much interested in visiting medical shrines and has recorded these pilgrimages in some charming papers, such as his paper on Francis Adams of Banchory, published in the *Southern Medical Journal* for April, 1936, and on William Withering, published in the *Bulletin of the History of Medicine* for July, 1942. Dr. Moorman was the author of two notable books in the historical field—*Tuberculosis and Genius*, published in 1940, and *Pioneer Doctor*, which appeared in 1951. The former is an interesting study of the stimulating effect of the tubercle bacillus on such varied individuals as Robert Louis Stevenson, Schiller, Molière, Keats, and Saint Francis; the latter book is a very human and intimate account of his own medical activities through the years, the "unadorned story of a doctor who traveled to the country in Oklahoma at the turn of the last century with three questionable assets: a medical diploma, a desire to see the West, and an inferiority complex."

Personally Dr. Moorman was a quiet, gentle person, kindly and genial, with a very keen sense of humor. He was an extraordinarily good story-teller, whose conversation was always interesting, sparkling and showed the breadth of his interests and the depth of his knowledge. He was withal a gregarious person, and his large circle of friends feel a deep sense of personal loss at his passing.

RALPH H. MAJOR

ANNOUNCEMENTS

AMERICAN ASSOCIATION OF THE HISTORY OF MEDICINE

TWENTY-EIGHTH ANNUAL MEETING, DETROIT, MICHIGAN, 12, 13, 14, MAY, 1955

Under the joint efforts of Dr. A. H. Whittaker of Detroit, and Dr. Erwin H. Ackerknecht of Madison, plans for the 28th Annual Meeting are progressing very favorably. The Park Shelton Hotel which is to be the headquarters hotel is centrally situated within convenient distance of most of the meeting places. Dr. Whittaker is not only allowing time for papers to be presented but is arranging a most interesting series of talks, exhibits, and visits centering about the great historical resources of Detroit. Dr. Ackerknecht is sifting out a most interesting group of papers and also plans on featuring two symposia; one on philosophy and medicine, and one on the history of hospitals.

The Garrison lecturer will certainly come up to the high standard set by the Garrison lecturers of the past. An outstanding speaker has also been selected for the banquet session which will probably take place Friday evening and which is always a highlight of the Annual Meeting.

A visit to the Henry Ford Museum and Greenfield Village at Dearborn, Michigan, will probably be one of the most enjoyable sidelights that we have to look forward to. Members who wish to bring wives and other guests may be certain that they will be most welcome.

For any further information contact may be made either with Dr. Alfred H. Whittaker, Chairman of the Committee on Local Arrangements, or Dr. Erwin H. Ackerknecht, University of Wisconsin, Madison 6, Wisconsin, Chairman of the Committee in Charge of Arranging for the Papers on the Program, or with the Secretary of the Association.

SAMUEL X. RADBILL, M. D., Secretary
7043 Elmwood Ave.
Philadelphia 42, Penna.

NATIONAL NEWS

Chicago

The Society of Medical History of Chicago has scheduled an open meeting for January 19, 1955, with the following speakers: Frederic Stenn ("Dr. Samuel Guthrie, Discoverer of Chloroform"), Nell Snow Talbot ("Oliver Wendell Holmes —Novelist, Poet Essayist"), and Thomas E. Keys ("A Stained Glass Window on the History of Medicine").

Cleveland

A meeting in commemoration of the 750th Anniversary of the death of Maimonides was held on December 13, 1954, under the sponsorship of the Howard Dittrick Museum of Historical Medicine of the Cleveland Medical Library Association,

with the cooperation of the Jewish Community Federation, the Handerson Medical History Society, and the History of Medicine Division of the Armed Forces Medical Library. After an address of welcome by the President of the Cleveland Medical Library Association, George Sarton spoke on "Maimonides, Philosopher and Physician," and Rabbi Abba Hillel Silver on "The Ethical Concepts of Maimonides." Copies of Dr. Sarton's address, which will be published in the January issue of the *Bulletin of the Cleveland Medical Library*, may be obtained by writing to Miss Genevieve Miller, Cleveland Medical Library Association, 11,000 Euclid Avenue, Cleveland 6, Ohio.

New Haven

The Beaumont Medical Club met on October 29, 1954. Norton Canfield spoke on "The History of the Term Audiology" and Everett Rademacher on "Medicine and Medicine Stamps of the Civil War Period." At the business session, a committee was appointed to examine ways and means of financing purchase of the Beaumont homestead in Lebanon if this ever becomes a possibility.

Prize Essay in the History of Medicine

Henry and Ida Schuman of New York take pleasure in announcing an annual award of $250.00 for an original prize essay in the history of medicine. The donors point out that the term "history of medicine" should not be too narrowly considered, i. e., that themes might range from fresh interpretations of the classical medical writers and their contributions (revealing the origin and growth of medicine and other sciences such as chemistry and physics) to social ideas in medicine and/or the relations between medicine and literature.

Medical students and internes in any American or Canadian institution are eligible for the award. Papers should run approximately 5,000 words in length and should be submitted by April 1 of each year to the *Journal of the History of Medicine* whose editorial board would pass on the suitability of the winning essay for publication in the *Journal* at an early date. Judges of the essay award will be: Dr. John F. Fulton, Professor of the History of Medicine, Yale University School of Medicine; Genevieve Miller, Cleveland Medical Library; and Dr. George Rosen, Professor of Public Health Education, Columbia University.

NEWS FROM ABROAD

Brazil

The Brazilian Institute of the History of Medicine announced celebration of its ninth anniversary by a "History of Medicine Day" with a special program on November 30, 1954.

Scotland

The Scottish Society of the History of Medicine has published a Report of Proceedings for the Session 1953-54. Among other things, the Report gives an account of the meetings held at Edinburgh (October 23, 1953), Glasgow (February 27, 1954), and Edinburgh (June 26, 1954). At the fifth annual general meeting the officers were unanimously reelected. Dr. John Ritchie is president and Dr. H. P. Tait (137 Colington Road, Edinburgh 11) honorary secretary of the Society.

BOOK REVIEWS

HENRY E. SIGERIST. *Grosse Aerzte.* Eine Geschichte der Heilkunde in Lebensbildern. Dritte durchgesehene und vermehrte Auflage. Muenchen: J. F. Lehmanns Verlag, 1954. 440 pp. Ill. D. M. 24.

Dr. Sigerist's "history of medicine in biographies" has lost nothing of its charm during the more than twenty years since it appeared first. It is indeed still producing "admiration and enthusiasm" for its heroes and their profession and, may we add, giving a surprising amount of information and insight concerning their work. In order to write such a history through biographies the rare combination of great scholarship and literary skill was needed which has characterized Dr. Sigerist's work throughout his long and glorious career. Theoretically it might at first sight appear problematic to use exclusively a biographical approach for such a task. But it becomes soon evident that for the author the personalities of the great doctors are symbols for larger movements and he never loses himself in anecdotic trivia. The book is thus an excellent introduction into the history of medicine as well as a source of enjoyment and information for those already familiar with the history of medicine.

For those who do not yet know the book it might be mentioned that its 62 biographies reach from the mythical Imhotep and Asklepios through Hippocrates, Galen, Paracelsus, Sydenham, Boerhaave, Laennec, Pasteur, Osler to Dr. Sigerist's own teachers Friedrich von Mueller and Ferdinand Sauerbruch. This new edition has been brought up to date on many details and has been greatly enriched through the addition of the biographies of Cajal, Pavlov, Cushing, von Mueller and Sauerbruch. For the latter three portraits the author uses quite successfully personal impressions. The book is richly and beautifully illustrated. It is to be hoped that the success of this new German edition of the "Great Doctors" will be a stimulus for a new edition in the United States where the book has been out of print all too long.

ERWIN H. ACKERKNECHT

L. FABIAN HIRST. *The Conquest of Plague.* A Study of the Evolution of Epidemiology. With a Foreword by William MacArthur. Oxford: Clarendon Press, 1953, xvi + 478 pp. Ill. $11.00.

On the first hundred pages the author reviews the theories concerning the origin of plague as they prevailed from the beginnings of history to the end of the 19th century: the supernaturalistic, the miasmatic and the contagionist theory. No new materials are offered here, but it is a convenient summary, sometimes not too clearly arranged.

The author then describes the basic modern discoveries, so closely connected with the history of the third pandemic starting in 1894: the discovery of the

plague bacillus, of the role of the rat and eventually of the rat flea; of sylvatic plague, and of interhuman plague (pneumonic and caused by human ectoparasites).

The basic epidemiological problems: periodicity, territorial spread and territorial immunity as well as control measures are discussed on the basis of the existing knowledge. The author has for 22 years done practical antiplague work in Ceylon, made important contributions to our knowledge concerning the influence of different flea species (good and bad transmitters) on the course of plague epidemics, and it is therefore understandable that he sometimes overemphasizes a basically correct position, the central role of the rat flea in the epidemic chain.

In spite of the tremendous increase of our knowledge concerning plague, and of our preventive and therapeutic armamentarium, plague is by no means a thing of the past. It remains not only endemic in the agglomerations of the Far East; for still unexplained reasons a third pandemic wave started only 60 years ago; five tremendous rodent reservoirs do exist now in North and South America, South Africa, Southern Russia, and Central Asia. Plague is not conquered, though as the author concludes: "Victory over man's most ancient and most deadly enemy seems now to be at last in sight." Under these circumstances this authoritative treatise on the epidemiology of plague, synthetizing an enormous material, written lucidly and with excellent judgment, is most welcome and deserves to be read widely. Although the bulk of the book is not historical in the strict sense of the word, it contains a large number of details and reflexions which will be of great value to the medical historian. It continues in a worthy manner the lineage of the great plague studies by men like Hacker, Haeser, Hirsch, Creighton, Sticker.

ERWIN H. ACKERKNECHT

GERASIMOS P. ALIVIZATOS. *The Early Smallpox Epidemics in Europe and the Plague of Athens after Thucydides.* Athens, 1950. 356 pp. (in Greek with English summary).

The author of this book is Professor of Hygiene at the University of Athens and of Epidemiology at the Athens School of Hygiene. These professional titles, together with his practical experience in treating smallpox patients and his knowledge of Greek and Latin, qualify him for taking up a much discussed subject, viz. the nature of the plague of Thucydides and of later epidemics. In his English summary, Professor Alivizatos concludes that the plague of Athens was smallpox and that the disease was identical with that referred to by Lucretius as raging in Rome at his time as well as with Galen's "long plague." The pandemic which Evagrios (6th century A. D.) described was, according to Professor Alivizatos, an incidence of plague *and* smallpox—such combinations being more frequent in earlier ages than they are now. At any rate, he believes smallpox well established before the Presbyter Aaron (whose "Pandects" are supposed to have contained a description) and Rhazes. There are, above all, two points which, in the author's opinion, facilitate historical diagnoses of exanthematous diseases. "Whenever in the case of a heavy epidemic disease a pustulous rash is described together with an ulcerous one starting from the head and progressively extending to the body

and legs" the disease is to be regarded as smallpox, "as no other heavy eruptive disease bears these features" (p. 346). The other point is that the Greek term *helkos* and its Latin equivalent *ulcus* originally implied scar formation (see pp. 345 and 349 f.) so that it did not require special mention where present.

OWSEI TEMKIN

F. N. L. POYNTER, *A Catalogue of Incunabula in the Wellcome Historical Medical Library*. New York: Oxford University Press, 1954. (Publication of the Wellcome Historical Medical Museum, New Series, no. 5). xv + 160 pp. Ill. $13.50.

The small but, we trust, select world of medical historians and of incunabulists has awaited with much anticipation the publication of this catalogue. For a long time it has been generally understood that Sir Henry Wellcome, though buying when the golden age for collectors was already in decline, had been able to amass to the time of his death in 1936 an extensive and rich collection of the cradle books of medicine. His generosity in making them available to historians has long been lauded, and it is with gratitude and satisfaction that we scan now the full story of their wealth.

Mr. Poynter has done his work well. The 610 incunabula and 22 fragments have been listed with a sure and skilful hand. The brevity of the entries is in itself commendable; full description of incunabula which are already fully described in the great national catalogues is not necessary, or even desirable, today, and ordinarily the details supplied here—author, title, editor or translator or commentator, added items, imprint, bibliographical references, format, size, variants from copies already described—are entirely adequate. A full description would on the other hand have been desirable for such an item as no. 373, which is not identified with any recorded copy, and in some cases the incunabulist would have liked a closer collation of variants. Mr. Poynter completes his descriptions with details of binding, provenance, and acquisition and often, to the immense benefit of historians, with a statement on medical content. Incunabula are coming to be studied more and more for content, and correspondingly less for typographical details; these statements on content, therefore, and the subject-index which is included at the end with the usual bibliographical indexes constitute one of the most valuable features of the catalogue and will be consulted repeatedly by historians.

Of the general methods employed by Mr. Poynter two may give rise to some confusion. Duplicates are entered successively after the first copy in the series of numbers, and several titles for any one author are entered not alphabetically, and then chronologically according to edition, but entirely chronologically, so that, for example, editions of the *Secreta mulierum et virorum* of Albertus Magnus printed in 1490 and in 1500 are separated by ten other items which represent in turn nine other works. Misprints are exceedingly few; such errors as *BM II 363* for *BM II 383* (no. 32) and *Pe 1542* for *Po 1542* (no. 246) can be quickly and

easily corrected and the bibliographical references which have dropped out from no. 119 supplied. Dean Putnam Lockwood in his *Ugo Benzi* (1951), p. 398, lists a copy of the edition described in no. 313 also for the University of Munich. There are indications that catalogues of incunabula published by two large medical libraries in America in recent years were known, but, if we except Klebs, the only publication listed in the field from the land of Sir Henry's birth is an outdated little book of 1889.

The treasures are here, and Mr. Poynter has catalogued them well, but some words of caution must be said regarding their extent and their content. Of the 610 items listed apart from the fragments, 52 are second, third, and (in one case) fourth copies, a number by no means excessive in view of the fact that some were purchased with intent to supplement imperfect first copies. Imperfections, as a matter of fact, again apart from the fragments, loom sometimes large. Generally the specific leaves missing are designated, sometimes it is stated only that a few (no. 286) or some (no. 150) or several (nos. 98, 199, 275, 304, 518, 519, 523) are wanting, or simply that the copy is imperfect (nos. 51, 416, 443, 475, 610). The most serious gaps occur where in copies for which there is no duplicate only one or two volumes or books of an edition printed in five volumes or books are present (nos. 104, 105), or of a 1-volume edition only 16 of 42 leaves (no. 78), 68 of 106 (no. 118), 37 of 376 (no. 170), 22 of 68 (no. 246), 56 of 135 (no. 526). This is not to say, however, that the great bulk of the holdings are not perfect, and even these imperfections may be traced in some measure to the purchase of whole collections.

The same practice and a laudable desire to set the history of medicine in the frame of general culture are responsible for the inclusion of a large number of non-medical items. If we disregard the fragments and the 52 second, third, and fourth copies, of 558 items remaining only 314 have Klebs numbers. These Klebs numbers in turn include incunabula in many fields of science, and not alone in medicine. The Wellcome holdings are therefore more general than those in some medical libraries, and while it is pleasant and instructive to have assembled in this way books which could have been possessed by a Renaissance scholar-physician, and not to divorce medicine from life, the collection should not be compared in extent to that in a library which specializes in more purely medical items. It must almost stand comparison instead with the great and general national collections.

At least five items were acquired after the death of Sir Henry. It is greatly to be hoped that acquisitions can continue and that the collection, already so rich, can grow steadily in usefulness. Meanwhile we await with eagerness two catalogues which will assist greatly in the study of these incunabula, the Klebs catalogue which, an outgrowth of and also the basis for his list of scientific incunabula, is promised by the Department of the History of Medicine at Yale University, and the catalogue of all holdings in the Wellcome Library, whose 5000 manuscripts alone should be a mine of information. Both catalogues will serve to facilitate, along the lines already drawn by Mr. Poynter, the study of that phase of the Wellcome incunabula which is all-important to medical history, their subject-matter.

DOROTHY M. SCHULLIAN

ROLAND H. BAINTON. *Hunted Heretic: The Life and Death of Michael Servetus, 1511-1553.* Boston: The Beacon Press, 1953. xii + 270 pp. Ill. $3.75.

The present work embodies the Tipple lectures delivered by Professor Bainton at Drew University in 1952, the fourth centenary of the death of Servetus providing an appropriate occasion for publication. The book is based upon researches by the author which stretch over more than a quarter of a century, and the result is a comprehensive account of the life and thought of Michael Servetus within a concise compass. In keeping with the limited period occupied by medical activities in his many-sided career, though perhaps not with their historical importance, only one tenth of the book is concerned with the medical work and writings of Servetus. However, the remainder, which is devoted mainly to the development of his theology, serves as a very necessary background to the understanding of his physiological views, for in the work of Servetus we find the most intimate and direct connection between the Protestant Reformation and the scientific revolution of the 16th century, his theology having an important bearing upon his theory of the pulmonary transit of the blood.

Throughout the chapter on Servetus as "Doctor of Medicine," Professor Bainton makes clear this connection, though it is perhaps illustrated rather than analysed. Thus the reduction of the traditional three physiological spirits to one by Servetus is described merely as being 'in accord with the temper of his age,' without any further elaboration of the nature of the accord or of the reasons why Servetus made this particular reduction. Being an anti-trinitarian in theology at the time of *l'uomo universale*, it is perhaps not surprising that Servetus should have opposed the spiritous triad of traditional physiology, particularly when the medieval synthesis of theology with natural philosophy, with its central concept of the universe ordered hierarchically in triadic groupings at every level, was being criticised from a variety of standpoints.

On the positive achievement of Servetus in physiology—the theory of the pulmonary transit of the blood—Professor Bainton gives an excellent and very well documented account. The empirical evidence upon which Servetus based his theory, and the question of the priority of his discovery, are adequately discussed, but fuller treatment is accorded to the theology with which the theory of the pulmonary transit of the blood was intertwined. The author indicates that "A question vastly more interesting than the priority of discovery is the philosophy of man without which even dissection might never have led Servetus to his significant observations." Professor Bainton certainly arouses interest in this question, and his book is a welcome addition to the understanding of one of the more enigmatic, but significant, innovators of the 16th century.

STEPHEN F. MASON

JOHN F. FULTON. *Michael Servetus Humanist and Martyr.* With a Bibliography of his Works and Census of Known Copies by Madeline E. Stanton. New York: Herbert Reichner, 1953. 98 pp. Ill. $8.50.

"The old enemy of Holy Trinity that is of all true Deity, that monstrous heap of all putrid and portentous heresies, Michael Servetus." This is the verdict of Melchior Adam in his Life of Calvin (*Decades duae continentes vitas theologorum exterorum principum qui ecclesiam Christi superiori seculo propagarunt et propugnarunt*, Francofurti 1619, p. 87). It reflects the opinion held generally in Protestant circles at this time, as shown for example in Alexander Ross's *View of all Religions*. According to this, Servetus "disguiseth his monstrous opinions with the name of Christian Reformation," held horrid blasphemies, regarded "the Holy Ghost to be Nature," "would reconcile the Turkish Alcoran to Christian Religion," "declares himself Prince of the Anabaptists," etc., etc.

It is well to remember all this at a time when religious intolerance seems to belong to the bygone expressions of legalised human wickedness, and perhaps only comparison with totalitarian dictatorship leads us to understand the climate of ecclesiastical struggle and reformation, in which the reformers rivalled in paranoic cruelty the jurists and inquisitors of the Church. As the peasants' wars show, it was not necessarily purely religious controversy, but this bound up with political and social upheaval. Paracelsus, the religious and social reformer, is an example in question. He had much in common with Servetus, notably the hunted life of the enemy of ruling power and opinion. But Paracelsus escaped the martyrdom which made Servetus immortal, as it immortalised Giordano Bruno. Servetus' teaching is predominantly religious and dogmatic. That this religious mind should have grasped the anatomical concept of the pulmonary transit of blood will not surprise those who have studied Roland H. Bainton's masterly essay on the subject (*see* this *Bulletin*, 1951, 25:1). No division could exist for the mind of Renaissance man between science and religion, for God was immanent in beings and animating them. In us the Divine is breathed into the ever moving blood with the air; blood is continuously regenerated by this contact with air in the lung (and not in the heart) and thus moves through the lungs in amounts bigger than those needed for mere nutrition of the lungs ("tam copiosus"). As Bainton says (*loc. cit.* p. 7), "He was never quite sure whether he was talking the language of physiology or religion. We have difficulty in understanding him because we live in a generation in which science has been secularised." Hence the necessity for a critical presentation of his work as a whole, including a new appraisal of his position in the history of circulation.

The first condition to be satisfied is that we should know what his literary remains were and where we can find them. With the present book, Fulton and Stanton have given us, for the first time, the indispensable basis for all future Servetus research—a full bibliography and collection of source materials. We find here fully detailed and annotated accounts of all editions (including full title, collation, contents and census of existing copies) of: "The Errors of the Trinity" (1531), "Dialogues on the Trinity" (1532), "Ptolemy's Geography" (1535). "Apology against Leonard

Fuchs" (1536), "Syrups" (1537), "Discourse in Favour of Astrology" (1538), The "Pagnini Bible" (1542), and, most important, the "Restoration of Christianity" (1553). Facsimiles of the title pages, sample pages of manuscripts and of the passages concerning the pulmonary transit of blood render the book a delight for the bibliophile. It is introduced by a learned survey of the life and work of the "gallant spirit who paid the supreme price for what he held as Truth." Fulton leaves the question open as to how Servetus arrived at his knowledge, but concedes that he was responsible for the statement in 1546 (or possibly earlier, in a manuscript, and 1553 in print) that "the blood passes from the right to the left side of the heart by going through the lungs" (p. 45). The implication here is that Servetus said that all the blood passes this way. This point seems to deserve further study in view of the critical restrictions imposed by Max Neuburger (*Arch. Gesch. Med.*, 1930, 23:7) and Izquierdo (this *Bulletin* 1937, 5:914). It is difficult to deny that Servetus still believed in an independent venous flow of blood to the organs (and therefore was not the "discoverer of the lesser circulation") but he allowed a much bigger proportion of the venous blood ("tam copiosus") to run through the lungs than did Galen. He stated that the aeration (regeneration) of blood takes place in the lungs and not through the heart septum, although he was not clear as to the impermeability of the latter, as Temkin has shown (this *Bulletin*, 1940, vol. 8, p. 731). These facts acquired fundamental importance later on. The situation invites a comparison with that of Cesalpino—in whom we also find (especially in his earlier texts) relics of Galen's doctrine side by side with the new knowledge of the "continual motion of blood through the veins to the heart and through the arteries away from it."

The present book, a delightful addition to the masterly bibliographies which we already owe to the author, is a sine qua non for the historian of medicine and civilisation.

WALTER PAGEL

CHARLES DONALD O'MALLEY. *Michael Servetus.* A Translation of his Geographical, Medical and Astrological Writings with Introductions and Notes. Philadelphia: American Philosophical Society, 1953. 208 pp. Ill. $3.00.

The year 1953 was the 400th anniversary of the death of the arrogant and brazen Miguel Servet (1511-53). Because of a controversial book written in his youth this unfortunate Spaniard became the hunted heretic leader of unitarianism who spent the rest of his life in disguise under the pseudonym of Villanovanus, earning his living as the proofreader-editor of publishers, student and practitioner of medicine, lecturer and writer on other controversial topics, theological as well as medical. His medical writings are second class at their best, and he would indeed have been forgotten long ago among physicians but for the fact that, in his *Christianismi Restitutio* (1553), he tried to explain a theological question, the relation of Christ and the Holy Ghost, by a physiological analogue, the aeration of the blood in the lungs and its further change after its return from the lesser circulation to the left ventricle of the heart. For this comparison he is considered the discoverer of the lesser circulation. This work also led to his detection under the pseudonym, and it caused his execution at the stake by Calvin in Geneva.

For the celebration of the Servetus anniversary, theological and medical scholars prepared and published articles and books during 1953. R. H. Bainton's Servetus biography (Boston, 1953) is such. C. D. O'Malley, professor of history at Stanford University, has contributed a small volume in which he has printed a revised form of a rough English version, made earlier for his own use, of some portions selected from six works of Servetus. These include (1), (2) several annotations to the two editions (1535; 1541) of the Geography of Ptolemy, (3) his Apology against Fuchs (1536), (4) the whole treatise on Syrups (1537), (5) his Discourse in Favor of Astrology (1538), and (6) the famous passage on the lesser circulation. Facsimiles of the title pages, and short bio-bibliographical introductions interrupt the monotony of the text. Those who wish to use the book for later references must prepare their own indexes.

Some of the theological works of Servetus are now bibliographical rarities. The *Christianismi Restitutio*, for instance, was burnt with the author, and only two complete copies escaped the fire. Some of his medical works are also rare, though not the treatise on Syrups which survived in several editions. Several reprints and/or translations (some only in manuscript) of selected chapters from his various works show the continued interest in Servetus throughout the centuries. A selected bibliographic list is available in Bainton's above mentioned book where the 75 related articles of Henry Tollin, the eminent Servetus scholar, are also enumerated.

One might wonder why nobody in recent years took the trouble of republishing these book rarities. It is true that the original text of the medically important portions of the Servetian works is also available now in various reproductions but they are mostly scattered in scholarly studies published in hard-to-get journals. It would have been of considerable value if, together with his English translation, O'Malley had also given us the original Latin text of Servetus, since a bilingual edition provides greater pleasure to many and also offers a solid basis for the better comprehension of the casual obscurities.

Translations are chiefly for general readers; since the scholars need original sources and will not be satisfied with anything else. The justification of this book is that it wishes to acquaint the general reader with the non-theological works of Servetus. For this purpose, as the Foreword states, the translator wanted "to produce a literal rather than an elegant rendering, and especially has an effort been made to avoid presenting an interpretation based upon what the person of the twentieth century might suspect Servetus to have meant."

But a plainly literal English rendering of 16th century Latin texts, especially of highly technical writings on medical topics, will hardly make the old thoughts and opinions comprehensible for 20th-century strangers. He who wishes to remain tied to Latin syntax and grammar in his English talk must be prepared to supply an abundance of footnotes in order to make his translation understandable and interesting for the reader. This translation of Servetus is equipped with very few notes.

A further disadvantage of the literal translation arises in this instance. Servetus, though a university man, wrote in a style of Latin as spoken in the era of the reformation. He used remarkable and peculiar expressions, and often crammed as much as possible into a sentence heavily loaded with accusativus cum infinitivo, ablativus absolutus, transposed adjectives, etc. His thoughts sometimes seem to

outrun his pen into a land of metaphysical obscurity. La Roche, in his *Memoirs of Literature*, also complained that Servetus expressed himself sometimes so confusedly that it was no easy matter to follow his line of thinking.

The long-winded and not very remarkable treatise on the Syrups " may occasionally make for a slight difficulty of comprehension if one has no knowledge of Galenical medicine," in the words of the translator. Hence, he briefly outlined in the introduction the physiological views of Galen on " concoction." This is not sufficient, however, to comprehend—without further recast in modern English—sentences of the following nature which mark the greater portion of the lengthy treatise (p. 110): ". . . Therefore bile may be mixed with the crude, or other mixtures may be made, but here we shall never employ the word crude unless something exists in it before the blood [has been perfected], which can be concocted into the blood. And if the humor existing before the blood [has been perfected] has been corrupted into a foreign quality it will no longer be crude. And so natural pituita and also acid pituita will be numbered among the crude. But salty pituita and others, if by concoction they can be turned into blood, we shall in no manner call crude. For the meaning of the word teaches us that we may call crude what has not yet attained the goal of the nature although suitable to attain it . . ."

Whosoever reads such a sentence in an English translation is inevitably urged to stop reading and to check the text with the Latin original. This is one reason for my belief that a new edition of this book would gain much by the addition of the original Latin text, either in the footnotes, or on alternate pages, or in form of an appendix to be printed perhaps in smaller type. It is also desirable to collect all the bio-bibliographical introductions into a separate chapter, instead of scattering and apportioning them to seven different sections of the book.

There are various minor inaccuracies in the English interpretation of Servetus, but I shall not delay in listing them, except the one that occurs in the passage on the lesser circulation in the following sentence of the *Christianismi Restitutio*: ". . . Atque ita tandem *a* sinistro cordis ventriculo totum mixtum per diastolem attrahitur, apta supellex, ut fiat spiritus vitalis." O'Malley's translation reads as follows: " Thus finally the whole mixture, suitably prepared for the production of the vital spirit, is drawn onward *from* the left ventricle of the heart by diastole." (p. 204, 4. line from bottom). On philological and physiological grounds his rendering of this sentence is incorrect. It should read: " And thus, *by* the left ventricle of the heart, the whole mixture is finally attracted during diastole, a stock ready to become vital spirit."

A careful check of the biographical and historical data in the introductory lines showed them reliable though not complete. Every part of the book, including its exterior, is an evidence of the translator's efforts to produce a book acceptable to the public and worthy of his own scholarship. And in that he succeeded, deserving our sincere applause.

CLAUDIUS F. MAYER

OTHO T. BEALL, JR. and RICHARD H. SHRYOCK. *Cotton Mather: First Significant Figure in American Medicine.* Baltimore: The Johns Hopkins Press, 1954. ix + 241 pp. Ill. $4.00.

The Reverend Cotton Mather, the dynamic Boston clergyman of the early eighteenth century, has long been considered a controversial figure and even by some as a pompous, reactionary theologian who spent his spare time persecuting witches and meddling with current medical practice. There is much in the sixty-five years of Mather's turbulent life to justify such an opinion, but to accept it as final judgment of his character is to ignore the cogent ideas expressed in his unpublished textbook, "The Angel of Bethesda," composed in the closing years of his life, after the smallpox epidemic of 1721, and presumably his mature thoughts on psychosomatic relationships, immunization for smallpox, the animalcular theory of disease, and the little recognized social aspects of medicine. On each of these topics he had pronounced opinions, emphasizing with considerable discrimination the medical and scientific discoveries of his time which later proved of major importance. Mather was like a sponge, soaking up all learning culled from his vast, miscellaneous reading and constantly squeezing out, drop by drop, a prodigious number of books and pamphlets. Some drops were large, some small; a few were clear but many muddy with the ancient humoral silt of medicine, enveloped in a tight, theological envelope.

"The Angel" in manuscript is hard reading. O. W. Holmes found Mather's medicine absurd and the Autocrat's opinion was widely circulated in 1883. Although Worthington C. Ford prepared a careful transcript of the manuscript about a generation ago, it was never published. A few others who examined the text found it dull or obscure at best, and it was left for Beall and Shryock to analyse and evaluate this medical document, fitting it into the frame of contemporary theological thought and medicine as practiced in Mather's time. This they have done admirably and with discrimination, realizing at the same time that "The Angel" was the only instance of systematic medical writing in this country prior to the national period. By careful dissection, after removing the theological envelope, so difficult to do for present-day readers, they have disclosed a new Mather, who derived inspiration from a dual orientation of science and humanitarianism. Although, as they write, Mather seems more learned than original, more a theorist than an observer, there are some remarkable exceptions to these generalizations, as in his observations on hybrid corn, or, again, in his apparently original view that the phenomena of immunization could be best explained in terms of pathogenic organisms. Unfortunately his theories remained almost unknown and therefore had little if any influence on the subsequent course of scientific thought. This can not be said of the practical aspects of his applied medicine, such as the triumph of smallpox inoculation as instigated by Mather and practiced by Boylston. The history of immunology began in the Boston of 1721, and for this alone Cotton Mather might well be considered as the first significant figure in American medicine.

The book, which originally was printed in the *Proceedings of the American*

Antiquarian Society, is well produced, with a frontispiece of the traditional portrait of Mather and a facsimile of the manuscript titlepage of "The Angel of Bethesda" from the original in the American Antiquarian Society. The appendix (pp. 127-234) includes certain selected chapters from "The Angel," omitting those containing only long lists of remedies, and considered as "meaningless" by the authors. The text is that of the Ford transcript which was found, by comparison with the original manuscript, to be entirely reliable. There is an adequate index.

HENRY R. VIETS

ROBERT MONTRAVILLE GREEN. *A Translation of Luigi Galvani's De Viribus Electricitatis in Motu Musculari Commentarius.* Commentary on the Effect of Electricity on Muscular Motion. Cambridge, Mass.: Elizabeth Licht, Publisher, 1953. xx + 97 pp. Ill. $4.00.

It is strange that so famous a classic as Galvani's *De Viribus Electricitatis* has not appeared earlier in an English translation, for it is in this *Commentary* that he describes the experiments which led to his discovery of "animal electricity." Historians of science trace the beginnings of our modern practical application of electrical power back to the dispute which immediately followed the publication of this *Commentary* between Volta and Galvani as to whether the source of this "animal electricity" was really within the animal itself, or whether it was the effect of the application of dissimilar metals to living nerves and muscles.

It is a difficult task to render into present day English the ideas which Galvani and his nephew Aldini expressed in Latin a century and a half ago. Dr. Robert Montraville Green, Emeritus Professor of Harvard Medical School, has now made the attempt, and many of his phrases, such as "Whereby forsooth it is established" (p. 66), or "But these things, as I was saying, I was, as it were, imagining in my mind, chiefly with this purpose, that they might be recalled to consideration by the most learned scholars" (p. 76) are perhaps intended to give the reader a feeling of the XVIII century, but something less literal might have been easier to read. This reviewer must admit that he was baffled by: "and that from their strength especially as great a faculty passes into animal electricity as in our experiments it was seen that animal electricity has for motion and to promote its exit from the muscles and its speeding passage along nerves, and to excite violent contractions of the muscles" (p. 80). Comparison of this with the original Latin shows that the confusion has arisen from the translator having rendered inconsistently into English a series of infinitives in parallel construction.

The brief *Introduction* by Giulio C. Pupilli, the academic heir of Galvani, since he is Director of the Institute of Human Physiology at the University of Bologna, is, however, a model of clarity, and the information conveyed is an excellent background for the reading of the translations from the Latin which follow.

Aldini's *Dissertation*, which precedes his uncle's *Commentary*, shows how closely the two had worked together, and following the *Commentary* is an exchange of letters between Galvani and Bassano Carminati, Professor of Medicine at the

University of Pavia. Although one ordinarily thinks of Galvani's experiments as having been performed on frogs, the *Commentary* shows that mammals were also used, and in the final letter there is the record that Galvani had, that very morning, successfully caused contraction of the muscles of a freshly amputated human leg and arm by the use of his "customary devices," *viz* a tin-foil armature placed on the nerves and "a little conducting metal cap, and singularly of silver . . . applied in such a way that with one part it touched the edge of the tin-foil, and with another the portion of the nerve uncovered or some contiguous part." (p. 97)

To a patient reader who desires a conscientiously literal account of Galvani's experiments on "animal electricity" this translation may be recommended.

J. M. D. OLMSTED

F. F. CARTWRIGHT. *The English Pioneers of Anaesthesia.* (Beddoes, Davy, and Hickman.) Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall Ltd. (Baltimore: The Williams and Wilkins Co.), 1952. x + 338 pp. Ill. $4.50.

Written with the aid of material from original and contemporary sources this volume is a splendid introduction to the history of inhalation anaesthesia. The author, who had originally planned a more inclusive study, found so much interesting material in the work of Beddoes and Davy that he soon realized that their contributions had been neglected and, therefore, greatly underrated. He remedies this deficiency by presenting a detailed account of their lives, building that of Thomas Beddoes around pneumatic medicine and Humphry Davy's around nitrous oxide. There is also a section on Henry Hill Hickman whose contribution is considered to form a logical sequence to that of Beddoes and Davy. A concluding essay completes the volume.

One of the tasks of a historian is to correct erroneous accounts, usually due to copying from secondary sources. Dr. Cartwright, who is anaesthetist for King's College Hospital and other English hospitals, has spared no pains in correction of such errors. For instance, there is an unsigned annotation which appeared in the *Quarterly Journal of Science and the Arts* in 1818 (4: 158-159) concerning the similar action of ether to nitrous oxide upon inhalation. This annotation has usually been attributed to Michael Faraday, and consequently Faraday has been given a small part in the development of anaesthesia. But it is now doubted that Faraday wrote the piece. The idea that Faraday was the author seemingly was a guess on Sir James Simpson's part and on this account most historians have perpetuated Simpson's suggestion without factual basis.

Inhalation anaesthesia as used in Guedel's * recent monograph is divided into four stages: (1) stage of analgesia, (2) delirium or dream stage, (3) surgical stage (4) stage of respiratory paralysis. Dr. Cartwright points out that the word "anaesthesia" as originally used in 1846 would in most cases now refer to analgesia,

* Guedel, A. E.: *Inhalation Anesthesia.* Ed. 2, New York, The Macmillan Company, 1951.

the first stage of anaesthesia. Wells "felt no more than the prick of a pin," Morton's patient at the first public demonstration "mumbled something about a scratch on the neck," etc.

Interestingly enough Dr. Frances Plomley, anaesthetist at the Kent Ophthalmic Institution at Maidstone, in a communication to the *Lancet* (Jan. 20, 1847, pp. 134-135) divided anaesthesia into three stages: (1) pleasurable feeling of half intoxication, (2) one of extreme pleasure where there is an indifference to pain, and (3) one of profound intoxication and insensibility. He attributed failure in anaesthesia to operating in the second stage, and advised that operations be carried out in the third stage. A few months later Dr. John Snow defined "five degrees of narcotism" (Snow, John: *On the Inhalation of the Vapor of Ether in Surgical Operations*. London, Churchill, 1847, pp. 1-4). So at least a few of the pioneers probably achieved anaethesia as of today.

Dr. Cartwright's thesis is that the introduction of anaesthesia was not brought about by a series of isolated and unrelated incidents. All the anaesthetic experiments that were done with the gases and with ether were dependent upon the work of previous investigators, notably the descoverers, and particularly Beddoes, Davy, and, to some extent, Hickman.

Another important factor that helped the American pioneers was the change of mind towards the pain of operations which came at the time of Wells and Morton. Without this change, the author concludes, the work of Wells and Morton would have met the same fate as that of Hickman. The English forerunners of anaesthesia prepared the way. But the initiative and resourcefulness of the American pioneers, I believe, brought about the acceptance.

THOMAS E. KEYS

FRANZ ALEXANDER and HELEN ROSS (editors). *Twenty Years of Psychoanalysis*. A Symposium in Celebration of the Twentieth Anniversary of the Chicago Institute for Psychoanalysis. New York: W. W. Norton & Co., 1953. 309 pp. $3.75.

This book is a story of success, the success of the psychoanalytical movement in the United States, mirrored in the achievements of the Chicago Institute for Psychoanalysis since its foundation in 1932 and highlighted in the papers on "the influence of the basic concepts of psychoanalysis on medicine and medical teaching in general, on psychiatry in particular, and on the social sciences."

Yet, the keynote of this justifiably proud celebration is the almost unanimous concern with the future rather than the past, with the tasks ahead, the problems unsolved, the dangers to be recognized and overcome. A future historian of the psychoanalytic movement reading this volume twenty or thirty years hence will—in retrospect—confirm or disprove the foresight, the hopes, and the anxieties formulated again and again by the twenty collaborators of this work. The ground for such anxieties is exactly the present success of psychoanalysis. As Alan Gregg phrases it, "Cinderella's unacknowledged child got into the Social Register" and finds itself now confronted by "the problems of surviving prosperity."

With his customary delightful frankness, intellectual breadth, and wisdom, Alan Gregg describes the place of psychoanalysis in medicine. Now, this frame of reference, medicine, is not static. Its concepts and practice have been changing. There is increasing emphasis on the natural history of disease, and here psychoanalytic theory has developed the "narrative aspect of disease," the "principle of continuity," and has "reaffirmed and reiterated the essentially historical character of the organism." Yet, it has somewhat neglected prevention, and it has laid less emphasis on the predisposing and perpetuating causes of illness than on the precipitating causes. In resonance with the present physical and chemical interpretations of cell-growth and function in physiology and medicine, some psychoanalysts have contributed to significant studies in psychosomatic medicine. Psychoanalysis has also shown "a creditable openness of mind toward the holistic and ecological view of organisms." Yet, psychoanalysts might have much to gain "if they showed more familiarity with heredity, conditioned reflexes, learning theory and the work of Ames and his colleagues on the nature of experience." Lastly, among the changing concepts of medicine "its ethical sensibilities are awakening to the inescapable responsibility that follows the new power of new knowledge." Here the attempts at short therapy have "much of the best kind of ethical concern for the patient's welfare!" In the field of practice of medicine Alan Gregg points out changes, also: a lengthened and specialized preparation; an increased attention to the need for medical care; an increasing proportion of elderly people in the population; and the further virtual certainty that knowledge will be advanced by research adding new potentialities to the physician's sphere of services. As to the teaching of psychoanalysis, some very serious problems will have to be solved: How can so many applicants be taught? How can they be kept under competent direction long enough to train reliable practitioners plus an elite of investigators? How can the cost be carried without institutional support? In point of educational organization the future of analysis is very likely to depart from the past. "Psychoanalysis suffers at present from its popularity with laymen." Persons needing psychoanalytic care greatly outnumber those who can afford it. In the care of indigents, analysis is behind the stage of medicine a hundred years ago. "Can psychoanalysts afford to neglect or ignore this change, effecting the rest of medicine? Where are you headed, for a cyclone cellar built of explanations?"

It seems that among American psychoanalysts at least the members of the Chicago Institute and those who have profited by it are aware of the problems and shortcomings mentioned by Alan Gregg.

Franz Alexander sketches the work of his Institute during the past twenty years of "transition from the heroic phase of a movement" into its consolidation and "a new era of responsibility." This required a change in attitude of psychoanalysts toward the non-analytical world, toward their own knowledge, and toward the methods of teaching and treatment. The primary objective of the Institute was the emphasis on systematic and collective research. The dream to build a really advanced school of learning; patterned after the university, led to the Associated Psychiatric Faculties of Chicago of which the Institute is a vital component. Just as rigid indoctrination of students was felt to be equivalent to paralysis, so it seemed necessary to revise constantly techniques of treatment and to experiment with new therapeutic methods. This reasonably unorthodox attitude,

this flexibility and openness of mind, experientally and experimentally, are to this reviewer hopeful signs for a final integration of psychoanalysis with psychiatry and with medicine in general. Indeed, the remaining papers of this symposium, as well as the factual reports on training and research by members of the Institute, show a similar fundamental attitude of critical research, of undismayed, controlled experimenting, of self-critique and willingness to bear criticism from others. Along with this goes a certain tendency to ward off accusations from orthodox quarters that all this activity is but a spreading thin and thinner of the original gospel. Indeed, the important articles by Maurice Levine, Martin Grotjahn, Lawrence S. Kubie, I. Arthur Mirsky, and Talcott Parsons are notable for the fact that the psychoanalyst's horizon was broadened without undue stretching of the psychoanalytic substance. This reviewer at least takes it for a sign of ongoing vitality and maturity that in these papers and discussions more questions are raised than answered, or even intended to be answered, as if to emphasize Franz Alexander's statement, ". . . we shall continue to have a great reverence for what is still unknown in the complex field of human nature, than to be proud of the little we know now."

WALTER O. JAHRREISS

ZACHARY COPE (editor). *Medical History of the Second World War: Surgery.* United Kingdom Medical Series, ed. Sir Arthur S. MacNalty. London: Her Majesty's Stationery Office, 1953. xix + 772 pp. Ill. 80 s.

This volume may be said to represent in essence a permanent tribute to the gallant war-time surgeons, not only of the Second World War, but of all wars. It is truly the saga of war-surgery, and therefore, the history of surgery itself. The evolution of our present concepts regarding the treatment of wounds and the management of trauma is traced in its entirety from ancient times through World War I, with its development of the principles of post-Listerian surgery, into the quiescent inter-war years, and then finally through World War II with all its many near miracles.

Sir Heneage Ogilvie states in the introduction to this book, "It is one of the anomalies of human nature that men are conscious of and animated by a common brotherhood only when they are united by a common danger." That these near miracles of World War II we speak of were but the direct result of that glorious "common brotherhood" of men which we once knew, cannot be denied. From this, perhaps, we can take a keynote for the future.

Sir Zachary Cope, as editor, has developed this volume primarily as a chronicle of surgery in World War II as experienced by the medical services of the United Kingdom alone. It is in no sense a rigid factual compilation of experiences and statistics but instead may more aptly be described as a narrative, bordering perhaps on historical fiction. This is the story of units and organizations together with the development of surgical attitudes and techniques; it is a record of dissappointments and failures as well as of successes and even miracles.

The surgical volume reviewed here represents but one of an extensive series

which is proposed to include eventually a World War II history of all branches of the fighting and civilian medical services in the United Kingdom. This is under the overall direction of Sir Arthur MacNalty. The United States has not as yet published any such comparable official surgical and medical history of World War II, although under the direction of the Office of the Surgeon General, U. S. Army, a series is in the process of compilation, one volume of which has already been completed, *The Physiologic Effects of Wounds*, by the Board for the Study of the Severely Wounded under the chairmanship of the late Dr. Tracey B. Mallory.

The British story is one told by a great many distinguished contributors and is based to a large extent on their own personal experiences. The general management of simple wounds is discussed by Sir James Ross and Sir Arthur Porritt. They point out that the handling of the wounds at the onset of World War II was essentially that of World War I tempered by the Spanish War influence of Trueta. With this as a point of departure, they discuss the advances which rapidly followed, such as the use of "split casts," intravenous fluids, gastric suction, sulphonamides, the widespread use and availability of blood and blood substitutes, the development of forward mobile surgical units, rapid evacuation, improved anesthesia, and finally the introduction of penicillin. The last two years of the war were described as being marked by the consolidation and crystallization of many ideas and varied experiences under all conditions of warfare.

Sir Lionel Whitbey discusses the experiences and organization of the excellent British Expeditionary Force Blood Transfusion Service, for the development of which he was mainly responsible. This example served as a prototype for Blood Banks in all the allied nations. No account is given, however, of the procurement and shipment of whole blood by the American Red Cross, Army, and Navy in vastly greater quantities for all allied forces later in the war.

Sir Zachary Cope himself recounts the whole problem of shock and resuscitation, outlining the evolution of our present concepts from the Cannon and Bayliss original report in 1919 and Blalock's outstanding contributions in 1940, through World War II to the final conclusions of the British Traumatic Shock Team headed by Professor H. N. Green of the Medical Research Council in 1945.

Abdominal and thoraco-abdominal wounds are discussed in detail by Sir Gordon Gordon-Taylor as regards incidence, treatment, and complications, together with a complete analysis of morbidity and mortality figures as well as the multitude of factors affecting these figures in all the theatres of operations. A similar coverage is given to the section on thoracic wounds by Brock, d'Abreu and Collis.

War surgery and traumatic surgery of all the specialties are thoroughly discussed. The section on injuries to the skull and brain is based on the writings of Sir Hugh Cairns and Sir Geoffrey Jefferson. Sir Harold Gillies together with many other contributors discusses the organization and experience of the plastic surgical centers. The orthopedic section is reviewed by H. Osmond Clark. Other sections give complete discussions relating to the war-time problems in the handling of arterial injuries, burns, blast effects, cold injuries, the crush syndrome, amputations, and artificial limbs.

Special problems and experiences relating to radiology, physical therapy, ophthal-

mology, oto-rhino-laryngology, urology, and peripheral nerve injuries are all given thorough consideration and evaluation.

In this discourse, however, one finds little consideration given to the early care and resuscitation of the wounded man within the division prior to his evacuation to a surgical hospital. This is an extremely vital and crucial period in the care of the wounded and one that is far too often neglected in terms of providing adequately trained surgical personnel and the necessary equipment at regimental and divisional levels. Treatment at this echelon determines to a great extent the soldier's ability to withstand surgical operation, being, moreover, an important factor influencing his postoperative course. It influences the degree of future functional rehabilitation and the rapidity with which he is returned to duty. Preoperative preparation begins the moment a man is seen by a company aid man. The excellence and proficiency of treatment received by the wounded soldier reaching a surgical hospital has a great many well documented testimonials, the volume here reviewed certainly being one of the more outstanding. The fact that mortality figures have been reduced in the United States Army from 8% in World War I to 4.5% in World War II and 2.3% in the Korean conflict stands in mute tribute to this fact. This "miracle" of military surgery is no cause for complacency, and added effort and emphasis must be directed toward more aggressive resuscitation in the forward areas prior to and during evacuation to surgical units.

As is so well documented and chronicled in this United Kingdom medical history, military medicine has indeed made remarkable progress. To Ambroise Paré at Metz, to Larrey during the campaigns of Napoleon, to Hunter McGuire, the Confederate Army Surgeon serving under "Stonewall" Jackson, or even to those gallant surgeons in clearing stations at Flanders in 1918, this story of World War II would truly have been a miracle.

VERNE CHANEY
I. RIDGEWAY TRIMBLE

WEBB HAYMAKER (editor). *The Founders of Neurology.* One hundred and thirty-three biographical sketches, prepared for the Fourth International Neurological Congress in Paris by eighty-four authors. With the bibliographical and editorial assistance of Karl A. Baer. Springfield, Ill.: Charles C. Thomas, 1953. xxvii + 479 pp. Ill. $10.50.

Intended as a text for an exhibit at the Fourth International Neurological Congress held in Paris in 1949 this volume was planned originally to contain biographical sketches of the 100 most outstanding neurologists of the past century, excluding those still living. The selection committee, however, could not agree upon such a number and so the list was enlarged to 133. It is perhaps fortunate that the editor left the roster somewhat flexible, for each of the biographees seems to merit a place in this roll of honor. In fact, the list might justifiably have been considerably lengthened. But it must be admitted that the editor has included most of the founders of neurology. By comparison with the members of the other neurological disciplines, the list of neurosurgeons seems abbreviated, and one misses such greats as William Macewen, Bergmann, de Martel, and others.

The book is divided into sections containing the biographies of neuroanatomists, neurophysiologists, neuropathologists, clinical neurologists, and neurosurgeons. The book consists of a series of biographical sketches, two or three pages in length, each illustrated with an excellent photograph, a half dozen or so references to the better known and most important works, and biographies of each neurologist. For the more serious student, these references should be of great value. Unusually complete name and subject indices are appended.

Although the individual biographical sketches vary in style and format, in each may be found the principle events of the founder's life, and his outstanding scientific contributions. Personal incidents and anecdotes illustrating the personalities of the neurologists add spice to what might be somewhat dry biography.

The introductory note on the meaning of academic terms used in European countries will be welcomed by many Americans, who, unacquainted with such terminology, are often confused by such terms as agrégé, Privatdocent, etc.

In this volume is much interesting information about the men who thought through the enigmas of the nervous system both in health and disease. Some indication will be found of the methods they have used to unravel the mysteries of neurology. In this sense, the book indicates the development of neurology, but it is not intended to be a history of that specialty. Yet the medical historian will find much of interest within its covers, and if he wishes to delve into the subject, the volume puts much basic material at his disposal. The neurologist, interested in the development of his specialty, will be delighted at such a concise and interesting compilation of biographical information.

A. Earl Walker

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